PUBLIC WORKS

An Engineering and Construction Journal

City County State

VOL. 63 MARCH, 1932 NO. 3

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To Think About:

At the age of 82—yes 82—Frank A. Wunder last year started in business for himself, after many years as a salesman for the Good Roads Machinery Co. He has an office in Philadelphia, and handles contractors' equipment, machinery and culvert pipe. That's the kind of spirit that should make us all stand up a little straighter, and face the world and all our trouble and worries a little more cheerfully. Congratulations, and the best of luck, Mr. Wunder.

In Lighter Vein:

Seems like our readers enjoy those "brain teasers" for we get a good many letters and solutions, all of which, we enjoy fully. Sorry we can't write a personal letter to every one that writes us, but we do appreciate their letters and we get a real kick out of our puzzle mail. Because of lack of space on this page, the solution of last month's "super-teaser" will have to be carried over to the rear. But here we want to thank those of our readers who have sent in such excellent material for the future. Here are a couple more to work on. Let's hear from you—if you can work them.

A St. Patrick's Special:

This Irish problem was sent in by D. B. Steinman, the well-known consulting engineer. He says: "I have noted with interest and appreciation the "brain teasers" which you run. I am venturing to submit herewith an original problem—which you will find requires both logic and algebra . . ." (It does.—Ed.)

On a certain job, Murphy, Flynn, Leary, Kelly, and Riley were Superintendent, Timekeeper, Laborer, Foreman, and Mechanic, but not respectively.

1) Six years ago, the Superintendent was twice as old as Murphy.
2) Kelly is as old as the Mechanic was when Leary's age equalled the combined ages of the Superintendent and Laborer.
3) Kelly's age added to twice Murphy's age gives the Foreman's age.
4) The combined ages of Murphy and the Laborer equal the combined ages of Kelly and the Superintendent.
5) Riley is as old as the Superintendent was when the Laborer was three times as old as Kelly.

What is the Foreman's name?
How old is Flynn?

The bogey time on this one is this office was an hour and a half. On the mark! Set!! Go!!!

Now here is an easy one sent in by Miss Carolyn Wachter: You have 100 unemployed men for whom you must buy tools. The council gives you $100. Wheelbarrows cost $10, picks $3, and shovels 50 cents each. You must have a tool for every man, and at least 1 of each kind. How many of each?

(Continued on Page 61)

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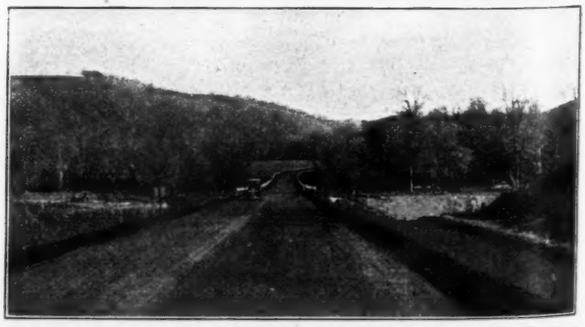

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PUBLIC WORKS

CITY COUNTY STATE

AN ENGINEERING AND CONSTRUCTION MONTHLY

Vol. 63 March, 1932 No. 3

Paving Practices in the United States

Some details of methods and materials employed, as reported by more than six hundred city engineers.

Concrete Pavement Joints

Spacing. Ideas as to the spacing of joints in concrete pavements are perhaps more varied than those on any other feature of such paving, varying from 15 feet to 300 feet or more. Of 457 cities reporting on this feature, 8 percent use less than 30 feet; 34 percent use a length between 30 and 39 feet; 16 percent between 40 and 49 feet; 21 percent between 50 and 59 feet; 8 percent between 60 and 69 feet; 3 percent between 70 and 79 feet; 3 percent between 80 and 99; and 5 percent 100 or over. (Some cities are duplicated in the above; as those which report "40 to 65 feet" would be listed three times). Three cities used joints only at the end of a day's work or when the work is interrupted for 30 minutes or more. Six use no joints, and two use them at street intersections only. A few use dummy joints with spacings ½, 1/3 or ¼ that between the through joints.

Kind of Material Used. Joints between concrete pavement slabs are almost always filled with some material of a more or less resilient nature. Of cities reporting to us on this point, 75% use pre-formed material; 9% use poured bitumen; 13% use either or both; 2% use "asphalt" (form not stated); and 1 percent use wood strips.

Reinforcing Concrete Pavements

Of about five hundred cities which lay concrete pavements and which have replied to our questionnaire on the subject, 70% use reinforcement. It is used by more than 50% of the cities reporting from the New England, Middle Atlantic, East North Central, West North Central, and West South Central states; and by less than 50% of the cities reporting from the South Atlantic, East South Central, Mountain and Pacific states.

Dividing the types of reinforcing into the two general classes of bar and mesh (including welded mesh and expanded metal) we find 44% using mesh, 22% using bars, 11% using both, and 23% failed to report on this.

The weight used per 100 square feet varies from 30 pounds (a few less than this) to 100 pounds; most, however, between the limits of 31 and 70 pounds. Of those reporting the weight, 6% use 30 pounds or less; 16% use 31 to 40 pounds; 32% use 41 to 50 pounds; 20% use 51 to 60 pounds; 15% use 61 to 70 pounds, and 11% use over 70 pounds.

In only one district do a majority of the cities report weights lying within a range of 10 pounds—57% of the Middle Atlantic report weights between 61 and 70 pounds. A range of 20 pounds includes 50% or more of the cities in all the other districts (except the Pacific; none of the 35 cities reporting from that district stated the weights used). The range of 51 to 70 pounds includes 75% of the South Atlantic and 50% of the E. S. C.; the range of 41 to 60 pounds includes 64½% of the E. N. C., 50% of the W. N. C., and 53% of the W. S. C. In the Mountain district, 60% lie below 41 pounds.

During February more than six hundred engineers replied to questions submitted by us dealing with details of their respective practices in laying street pavements. We give below synopses of their replies to some of the questions, and others will be given next month.

In order to indicate what, if any, effect geographical location or local habits may have, we have grouped the data by districts, as shown by the map on the next page.

Curing Concrete Pavement and Bases

There are four general methods of treating concrete pavements and bases during the curing period which are in more or less common use—applying water direct, covering with some material which is kept damp, covering with a bituminous emulsion, and use of chemicals.

Of about six hundred cities replying to a question on this subject, 30% use water direct; 11% by sprinkling, 7% by ponding, and the remaining 12% not specifying the method.

Covering with some material is reported by 38% of the cities; "dirt" by 14%, burlap or canvas by 11%, hay or straw by 8%, sand by 2½%, paper by

two cities in the Mountain district, sawdust by one city and shavings by another in the South Atlantic, while the remaining 1½% did not specify the covering material.

Bituminous emulsion is used by 8% of the cities.

Calcium chloride is used by 20% of the cities, some mixing it with the concrete, others spreading it on top of the pavement. Silicate of soda is reported by 4% of the cities.

The table indicates that the two methods in most common use in each of the nine districts is as follows:

New England—Burlap cover and water.

Middle Atlantic—Calcium chloride and emulsion.

South Atlantic—Dirt cover and water.

East South Central—Calcium chloride and dirt.

East North Central—Calcium chloride and dirt cover.

West North Central—Dirt cover and calcium chloride.

West South Central—Silicate of soda and dirt.

Mountain—Ponding and dirt cover.

Pacific—Bituminous emulsion and water applied direct.

Kind of Reinforcement Used

District	Total Reporting	None	Mesh	Bar	Both	Kind Not Stated	Weight per 100 square feet, Pounds: 30 or less	31-40	41-50	51-60	61-70	Over 70
New England	15	2	2	5	4	5	1	2	..	..	..	3
Middle Atlantic	99	8	38	19	14	20	1	..	7	5	21	4
South Atlantic	38	28	6	2	2	..	..	1	..	2	1	..
E. S. Central	14	8	1	1	1	3	..	1	1	1	1	..
E. N. Central	134	27	65	14	4	24	4	14	35	18	3	8
W. N. Central	66	10	20	10	6	20	2	9	9	3	1	..
W. S. Central	39	12	6	13	4	4	1	1	5	3	..	5
Mountain	24	17	4	1	..	2	2	1	..	2	..	..
Pacific	35	31	..	3	1	..	..	..	..	..	..	..
Totals	467	143	142	68	36	78	11	29	57	34	27	20

Methods Used in Curing Concrete Pavements and Bases

	Ponding	Sprinkling	"Water"	Dirt	Sand	Hay or Straw	Burlap or Canvas	"Cover"	Calcium Chloride	Silicate of Soda	Bituminous Emulsion
New England	..	2	4	2	1	..	6	..	4	..	..
Middle Atlantic	1	10	9	2	4	20	16	6	31	1	21
South Atlantic	2	4	9	10	..	1	8	1	2	4	2
E. S. Central	..	2	2	3	..	1	2	1	3	..	2
E. N. Central	9	19	19	26	3	22	23	4	63	6	5
W. N. Central	7	15	14	18	2	3	7	1	17	3	6
W. S. Central	8	4	9	12	2	..	1	1	1	12	2
Mountain	7	4	3	5	2	1	2	..	1	..	2
Pacific	8	8	9	7	1	..	1	..	1	..	11
Totals	42	68	78	85	15	48	66	14	123	26	51

Also use of paper was reported by 2 cities in the Mountain District; of sawdust by one in the South Atlantic and one in the E. N. Central; and shavings by one in the South Atlantic.

Map of the United States Showing Geographical Divisions Referred to in Article

Road Construction in McDowell County, West Virginia

By Charles H. Payne
County Road Supervisor, McDowell County

McDOWELL County, W. Va., has an area of 538.4 square miles and a population of about 90,000. It contains 350 miles of improved roads, 85 of which is state road and the remainder county road.

The topography is rugged, with elevations varying from 875 to 3400 feet. Practically all roads are on mountain side location, many cut through hard sandstone cliffs; the excavation necessary for a 26-foot roadway averaging 25,000 cu. yd. a mile, 75% rock. Maintenance of such roads also is expensive, involving constant work keeping ditches and drains clean and removing slides.

The county roads are constructed on as good locations as possible, with sufficient width to allow hard surfacing later, without further widening; and on this is built a base adequate to carry all loads, covered with a low-cost wearing surface which usually is applied a year or more later. The base is built of sandstone, of which there is abundance in the county, with shale from ledges or sand from stream beds as filler; but for the wearing surface, limestone is used, shipped in from adjoining counties.

The county road department has its own equipment and does practically all road work with its own forces, using prisoners as common labor, but not for foremen, shovel operators, drillers, truck drivers, etc.

After the roadway has been excavated and all drainage structures put in place, it is allowed to settle for a year or more before surfacing. Then sandstone is quarried near the job and dumped on the subgrade, where it is knapped and placed by hand; four inches being the maximum size of stone, and the depth being such as to afford a base 9 inches thick after compaction by a ten-ton roller. The knapping is followed as closely as possible by rolling and two men are kept busy leveling up the stone ahead of the roller; any unevenness that develops in rolling being remedied by redistribtuion of stone from high spots to depressions.

After thorough compaction, a filler of shale or clean sand is distributed over the base (shale, when used, being crushed under the roller) and leveled off with hand brooms and rolled until the interstices have been filled thoroughly. Meantime, traffic can continue using the road. If the wearing surface is not to be placed at once, the base is covered with about ¾-inch of the filler material.

The wearing surface is built up of a succession of heavy surface treatments or light "retreads"; usually two in consecutive years, and others as needed—an average of one treatment every three years. The material used is limestone chips and "Tarvia Retread." The first treatment consists of 30 lbs. of chips and a half-gallon of Tarvia per square yard. The base is thoroughly cleaned by power broom, aided by hand picking of caked material if necessary, and the chips are spread by hand from piles along the road side, or directly from trucks. The tar is then applied by means of a pressure distributor, the application being included in the price paid for the tar. This first treatment usually is not dragged, but should be rolled with a light roller.

In the second treatment, usually applied the year following the first, the amounts of chips and tar used depend upon the condition of the road, the roughness being the principal governing factor. A sufficient quantity is used to insure a smooth surface after dragging. The second and later treatments are always dragged with a Federal type drag.

Even though the base is substantial and carefully constructed, it is subject to settlement and movement, as is always the case in mountainous territory; but resulting irregularities of surface can be removed by dragged treatments as above, and at low cost.

The excavation costs are estimated to average 23 cts. per cubic yard of unclassified material. Stone base in place costs $1.50 per cubic yard. Surface treatment costs 15 cts. per square yard for each treatment.

The first road of this type was laid in 1925; the second treatment was applied in 1926, and the road

Newly graded road, showing rock cut

County prisoners laying base

has received two applications since and is in excellent condition and probably will not need another application for two years. The success of this road resulted in the adoption of this type of construction for all country roads. With the use of prison labor it is the most economical type in both construction and maintenance. On this first road the surface treatments over a period of seven years have cost a total of 60 cts. a square yard, including the original application.

The same type of surface has been used for resurfacing old roads, both bituminous and concrete; the roadway being widened in most cases, using strips of the heavy stone base constructed as above.

Necessary Characteristics of Traffic Line Paint

The California Division of Highways finds such a public appreciation of and demand for traffic stripes that the Maintenance Department is now spending nearly $100,000 a year on them. Of this amount about $80,000 is for paint, and the cost of the paint as well as its effectiveness, durability, etc., are of considerable importance. According to Thomas E. Stanton, Jr., materials and research engineer of the division, the paint should have certain well-defined characteristics.

In the first place, it must dry to such an extent in approximately one-half hour or less that it will not be injured by traffic. This eliminates oil paints, for the use of oil makes the paint slow drying and this drying time can not be shortened to the extent required for traffic lines without injury to the paint.

As a substitute for the oil paint there has, during recent years, been an extensive development and use of the lacquer type wherever accelerated drying is desired, such as for example in painting automobiles, furniture and traffic stripes.

The lacquer vehicle in which the white or colored pigment is ground consists of a nitro-cellulose or a gum dissolved in some highly volatile solvent such as alcohol, benzol, acetone, etc. When spread on a surface in a thin sheet, the solvent evaporates rapidly and leaves a hard residue.

Some solvents dissolve asphalt and this type of solvent can not be used in the manufacture of traffic lacquers. Some gums leave a brittle residue which flakes readily after evaporation of the solvent. This type of gum can not be used unless it is possible to add some ingredient which will act as a toughener. Any such adulteration produces a slower drying material and when used to excess may so lengthen the drying time as to render the product unusable as a traffic lacquer.

On the other hand, the residue, after the solvent has evaporated, must not be soft or sticky in the slightest degree; otherwise it will be readily discolored by dirt, grease and oil from the traffic which passes over it.

The residue must also be highly resistant to abrasive action, otherwise it will wear out in three to six months' time and rapidly lose its value as a safety guide, thereby requiring renewals at two or three times the ultimate cost per year of a line painted with a high grade, non-brittle abrasion-resisting lacquer which retains a high degree of visibility from nine months to a year. Practically all lines where traffic is reasonably heavy require renewal in from nine months to a year. In many cases, where the traffic is exceptionally heavy and consists of a large percentage of truck traffic, renewals must be made at intervals of three to six months.

The traffic line should also retain its color throughout its life. Thus, if a white line is desired it should remain white and not change to a yellow or dirty color through the action of the sun and other natural elements.

Because the use of lacquers for traffic lines is a comparatively recent development and no standard specifications have as yet been formulated which will insure a material complying with all of the desirable characteristics outlined above, the Materials and Research Department of the California Division of Highways has been conducting an extensive research of this problem for some time. As a result of this investigational work, a standard lacquer specification has been developed which, it is expected, will insure a high grade product with the resultant saving of thousands of dollars in cost and increase in utility.

G. H. P. Lichthardt, chief chemist at the laboratory, who is highly expert in his profession, has been carrying on an extensive investigation into the relative value of the commercially available gums and the proper solvents which must be used with these gums. Under Lichthardt's direction extensive tests have been made of the abrasive resistance of different lacquers when tested on the abrasion machine constructed at the laboratory.

To pass the specifications drawn up by Lichthardt, lacquer must not only pass a severe abrasive test, but must dry in from 15 to 30 minutes, have good flowage and covering properties, resist cracking under a severe bend test, resist disintegration in water and must not dissolve the asphalt in the pavement surface.

Further investigations have been conducted by Retla Alter of the laboratory staff to devise equipment for measuring the relative visibility of different surfaces by means of the photo-electric cell. Very encouraging progress has been made in the development of equipment for this purpose which it is hoped may be perfected to such an extent that information of value can be secured which will enable a more intelligent selection to be made of the material best suited for specific cases.

Discharge of Sewage Plant Operators

A large city and a number of towns in western New York recently dispensed with the services of experienced sewage works operators, due to political turnover. Such action is to be regretted, particularly in view of the fact that these operators, as well as other employees, were replaced by inexperienced workers.

Investigations by the Division of Sanitation revealed that some of the plants were receiving practically no attention, a condition which, if allowed to continue, would result not only in severe economic losses to the communities through plant deterioration, but also in a public health menace through pollution of streams and water supplies. The public and local health officials should insist that sewage treatment works be operated at all times under proper technical control and that competent operators be retained in charge of such plants, especially if there is no reasonable ground for dismissal.—*New York State "Health News."*

Designing Drainage Channels in Birmingham

By A. J. Hawkins,
City Engineer, Birmingham, Ala.

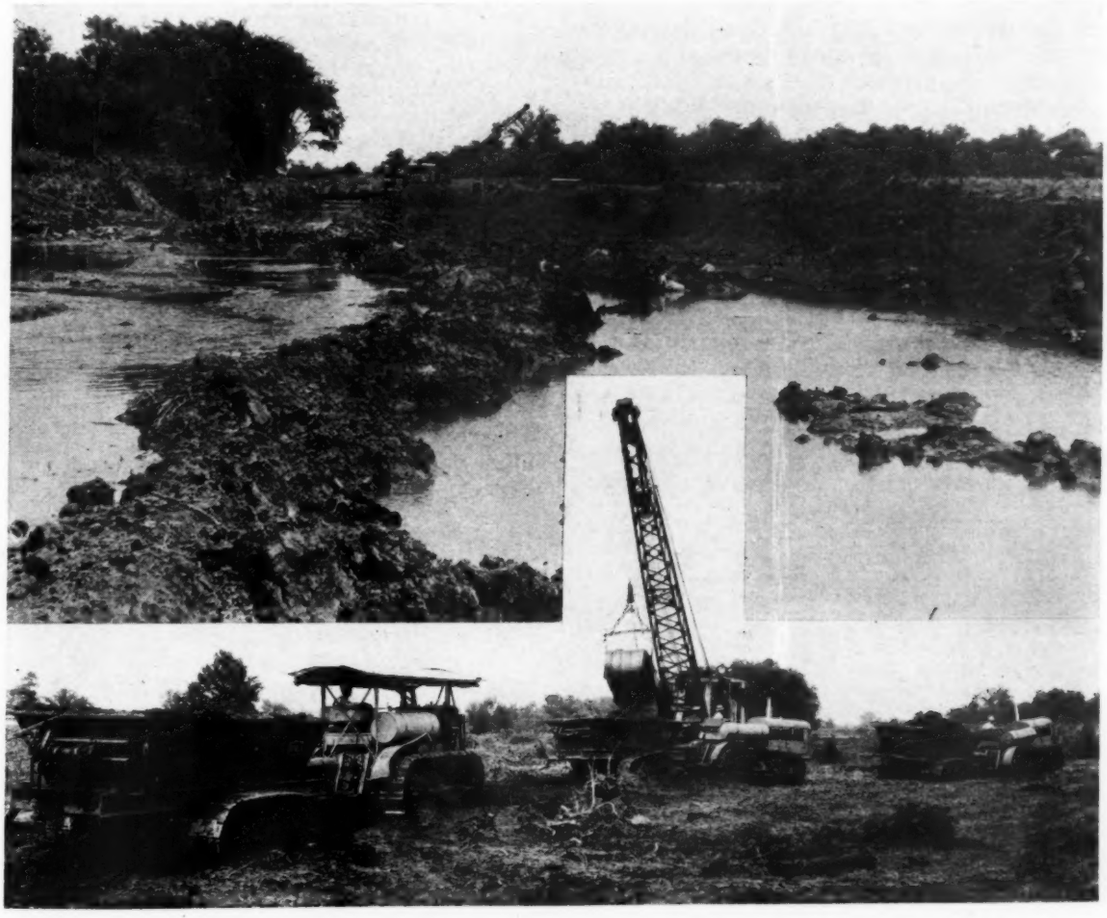
WITH the proceeds of a $3,000,000 bond issue voted some time ago for that purpose, the city of Birmingham, Ala., is now engaged in a major drainage project which consists largely in straightening and deepening the channels of two creeks which run through the city. This work was made necessary by the frequent overflows from these creeks, with consequent damage to property and even danger to lives of residents in the lower regions of the city; which need has grown more pressing each year owing to the rapid growth of the city. The present development is designed to provide for the demands of the next 15 years, after which it is proposed to further deepen and widen the channels and to concrete the bottom and sides at an estimated total cost of about $20,000,000.

Birmingham is an inland city of 264,000 inhabitants, occupying an area about 14 miles from east to west and six miles north and south. This area is crossed by two creeks called Valley creek and Village creek, almost the entire watersheds of which lie within the city limits. Village creek flows entirely across the city from east to west in a southwesterly direction, and Valley creek flows in the same general direction from the center of the business district west through one of the principal residential districts.

The city's business centers largely in iron and steel industries. There are four large blast furnaces located on Village creek and a number of smaller manufacturing concerns within the city limits. All of these have encroached more or less on the creek channel with their structures or waste products, and with the numerous railroad trestle crossings, have badly obstructed the channel. The same condition existed on Valley creek before these improvements began, but to a less degree.

The immediate cause of the city's undertaking the improvements was the flooding of property along the banks of the creeks and overflowing of storm sewers that empty into them after every excessive rainfall; the latter due to the increased runoff of rainfall due to growth of the city over the watersheds with the consequent increase of impervious areas.

The city at different times had made studies with a view to remedying local troubles, but it was obvious that permanent relief could be obtained only by an improvement of the channels through the entire city and continued sufficiently beyond it so that the creeks



Work on channel widening by Peterson & Simmons. Above—view of channel; shovel at work in background. Below—removing excavated material for filling low land.

should not back up into city area. With this in view, designs were prepared for new channels to care for the runoff from the two watersheds down to the western city limits, calculated for the next 15 years, with provision for later extensions to carry the runoff of the two sheds when they are both 100 per cent developed by the growth of the city over them. The area of Village creek watershed was found to be 24,000 acres, and that of Valley creek 9,000 acres.

Complete surveys were made of both creeks from their sources inside the city limits to points one to one and a half miles west of the city, locating all structures in, under, over, or along both banks of both creeks, all street and land lines, and the limits of the main and sub watersheds. Also 1,430 cross-sections and 3,233 soundings for rock were made. This was plotted on maps drawn to 100′ scale, and on them was laid out an alignment of a permanent channel to care for the ultimate runoff; and within the lines of this, a narrower temporary channel to serve for the next 15 years. A center line profile was drawn showing the present creek bed, water surface, rock line and proposed grade line. The present bed of the creek was lowered from one to five feet.

The new alignment for Village creek was 11.5 miles long, whereas the old channel was 12.8 miles. The size of the permanent channel varied from 144x9 feet to 37x7 feet, and that of the temporary channel from 70x9 to 20x7. The new alignment of Valley creek was five miles, only 300 feet shorter than the present channel due to the fact that this creek had been straightened by a land company several years ago. The permanent channels are to be lined with side walls and bottom, but the temporary channels will be unlined.

In designing the capacities of the two channels, the rational method was used. A study of the local rainfall and the U. S. Weather Bureau records of all excessive rainfalls here for the past 24 years, with a copy of all monthly maximum 5, 10, 15 and 20-minute rates, furnished data for plotting a time-intensity curve, by which the proper intensity for any given time flow could be determined. The formula of this curve is $\sqrt{\frac{17}{T}}$, where "T" is the time flow (not less than 10 minutes being considered).

The general form of the rational formula is $CAI+c_2$, in which A is the total acres of the watershed under consideration, I the intensity of the rainfall, C a coefficient expressing the per cent of rainfall reaching the sewer or channel, and c the number of cubic feet per second of constant flow in the channel.

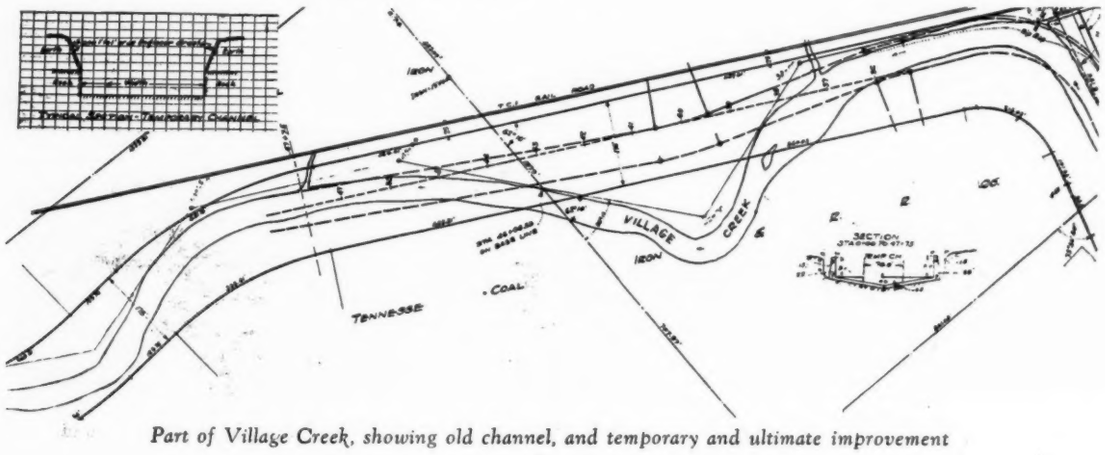
The determining of the value of C for the permanent channel, when the watershed will have been fully developed, necessitated a knowledge of what the nature of the developments will be, and the zone map of the city as fixed by the Zoning Commission was used to aid in determining this. The outlines of the different zones as designated for future development were drawn on the drainage map which showed outlines of drainage areas, and runoff values given each zone according to the nature of the development prescribed for it. The unzoned areas and areas outside city limits were also given runoff values. These values varied from 20 to 85 per cent of the rainfall and were arrived at after a study of values used for similar improvements in other cities, and a careful check (from local insurance maps) of existing values for similar improved areas.

The entire project was designed and the construction work is being supervised by the Engineering Department of the City of Birmingham, A. J. Hawkins, city engineer; J. D. Webb, principal assistant engineer; Maury Nicholson, drainage engineer; E. M. Owen and H. N. Payne, division engineers. The project was let in sections to several contractors, who are using the latest type machinery, including Caterpillar tractors and Link-Belt ditch diggers.

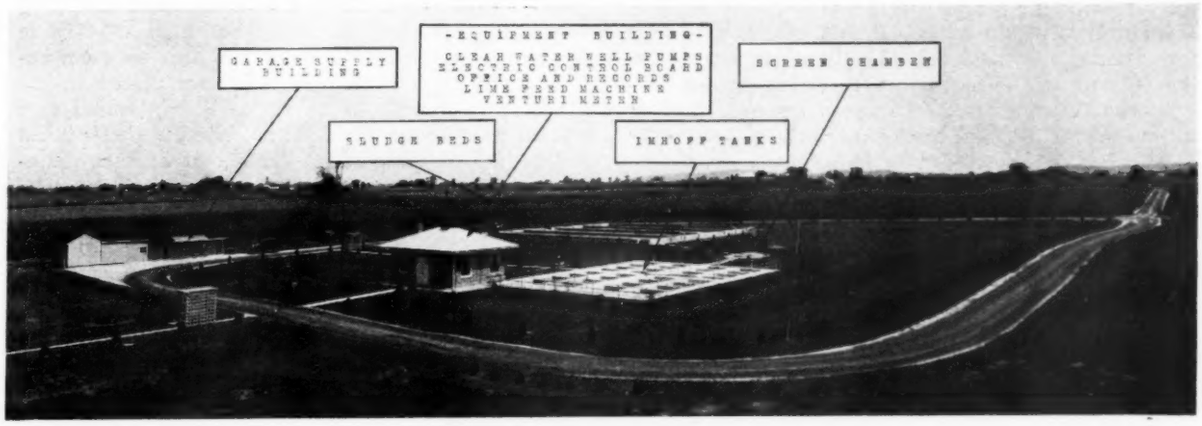
The illustrations show work on the stretch taken by Peterson & Simmons of Fairfax, Mo. In the view showing the creek, the water on the right fills excavation made by a Link-Belt shovel and removed by three Caterpillar "60" tractors and Euclid dump wagons. This equipment moved 1,000 cu. yds. of dirt in one night shift and 1,500 cu. yds. in a day shift. (They work days, nights and Sundays.)

This contractor removes all the earth down to rock for the full width of the channel, piling it over the adjacent low land. He also digs a ditch along the side of the channel and into this dumps the rock which is removed from the channel, filling the ditch with rock almost to ground level; then brings it up to level with earth.

Another contractor dumped dirt and rocks together on the bank of the channel and later had to haul it away; this double handling greatly increasing the cost.



Part of Village Creek, showing old channel, and temporary and ultimate improvement



General view of sewage treatment plant of Hanover, Pennsylvania

Sewer Rentals Pay for Treatment Plant

HANOVER, PA., a borough having 15,140 population by the 1930 census, has a sewage treatment plant which, including grounds, buildings and equipment, cost $79,827. The original contract was completed in 1929, and included a screen chamber, two Imhoff tanks, dry feed lime machine, chlorinating apparatus, and sludge beds, with necessary pumps, venturi meter, etc. The plant is not considered as a complete one, however; the manager makes this plain in his annual report, in which he says: "Attention is called that from time to time recommendation will be made to town council for additional units at the sewage treatment plant. Let it be fully understood that the plant was complete so far as it went with the money allotted, which was $85,000. The plant is operated in a preliminary manner. The designers of the plant gave consideration in making up the plans to provide for future additions as soon as money was available by the borough. Such additions would be a $100,000 sprinkling filter, sludge drying beds $10,000, etc."

Assuming the plant has ample capacity for 20,000 population, the cost of the plant as it stands was about $4 per capita, while the cost with $110,000 more spent for sprinkling filters, sludge beds, etc., would be $9.50 per capita.

The plant, which was designed by Fuller & McClintock, contains in addition to two Imhoff tanks of 7800 cu. ft. capacity each, a brick pump building housing a sludge pump, capacity 250 g.p.m.; a one h.p. sump pump; a one h.p. pump which feeds the 500-gallon pressure water tank for the chlorination apparatus; a dry feed lime machine, capacity 40 lbs. of lime per hour; a chlorinating apparatus, capacity 18 to 72 lbs. per 24 hours; a venturi meter, and uncovered sludge beds with an area of 10,210 sq. ft.

The sewage reaches the plant through a 21-inch vitrified pipe line. The average flow is 1,000,000 gal. per 24 hours; the total capacity of the plant is 1,400,000 gal. Chlorine is applied at the center of the Imhoff tanks at an average rate of 50 lbs. per million gallons. Lime at the rate of 140 lbs. a day is applied to the sludge in the Imhoff tanks.

An average of 2.0 cubic feet of screenings per million gallons of sewage is removed from the bar racks. As 98 per cent of the screenings are small, soft particles, the screenings are put in the Imhoff tanks. Gas vents are whipped down daily by the use of 2½ inch fire hose, this requiring about three hours. Another daily routine is the circulation of the sludge in the Imhoff tanks by means of the sludge pump, to secure better digestion of the sludge and reduce foaming; this circulation continuing for two or three hours, during which time the lime is added. The average time required for sludge digestion is 8 to 12 days. Sludge is pumped from the Imhoff tanks every ten days, on an average. Dry sludge is removed from the beds once a month at a cost of $12. It is hauled onto part of the 22 acres of land owned by the borough.

The cost of operating the plant last year was: Labor, $3,149; coal, $300; lime (at 4½ cents a pound) cost $202; chlorine (at 4 cents a pound) cost $346; electric power, $612; removal of dry sludge, $144; or a total cost of $4,753. In addition, $247 was spent on improvements to the grounds and buildings. This is about 32 cts. per capita per year, or $13.70 per million gallons. Interest and depreciation on the cost of the plant would add $18 or $20 to this.

The operation of the plant and sewerage system is paid for from sewer rentals. These totaled $20,474 in 1931, from 2,469 sewer services, an average of about $8.30 per service. The rental rates are as follows:

For residents—1 water closet, $1.25; each additional water closet $1; 1 bath tub, $1; each additional bath tub, $1; 1 kitchen sink, $1.10; each additional kitchen sink 60 cents; 1 wash basin, 50 cents; each additional wash basin 50 cents; 1 laundry tub, 75 cents; each additional laundry tub 75 cents; 1 urinal, 75 cents; each additional urinal, 75 cents; 1 shower bath, 75 cents; each additional shower bath, 75 cents; 1 cellar drain, $1.50; each additional cellar drain, $1.50.

Sewer rental schedule is for a six-month period.

No rebate will be allowed for vacancies or for discontinuance for a portion of six months rental period.

Sewer rentals outside of borough limits are 60 per cent greater than the regular charges within the borough limits.

There are three sewage pumping or ejector stations, operated by automatic electric control. One, of 100 g.p.m. capacity, serving 70 families, cost $60 per year

for current. Another, of 150 g.p.m. capacity, serving 160 families, with a lift of 50 feet, cost $180 a year for current; and the third, 150 g.p.m. capacity, serving 80 families, 53-foot lift, $72 for current. A miscellaneous charge of $24 per year for each injector station brings the total cost of the three to $384. The injector stations cost $500 to $1,000 each.

Main entrance to Hanover sewage grounds

The general maintenance of the sewer system (16 miles) costs about $4,000. The total cost of operating sewage treatment plant, injector stations and sewer system is therefore $9,384, or 62 cents per capita. This leaves about $11,000 of the income from service rentals to apply to interest, sinking fund, etc. The present value of sewers, injector stations, treatment plant and sewer cleaning equipment is given as $300,000; of which this balance would be about 3 2/3 per cent.

Sewer Rentals in Ardmore, Pa.

Lower Merion Township, Pa., of which Ardmore is the chief municipality, has provided by ordinance for the establishment of a system of rates to be charged all properties using the public sewers. The commissions consider this desirable in order that the cost of operation of the system may be charged against those citizens who use the sewers rather than against the entire township. The sewer rentals therefore are kept as nearly as possible equal to the cost of the sewers. For the year 1930 the sewer rental bills totaled $108,029, while the sewer costs totaled $107,834, of which $70,903 was for operation and maintenance, and $39,931 was for interest and sinking fund on sewer bonds.

The system includes five pumping stations and 248 miles of sewers. Of the total operating cost, $45,530 was for pumping 591 million gallons, of which $36,640 was for operation and $8,890 for interest and sinking fund.

The sewer rental rates resemble the "flat rate" used by certain water works systems. Sinks are charged $3.50 for the first and $1.50 for each additional; water closets, $2.50 each; bath tubs, $1.50 each; soda fountains, $1.50; garage drains, $5 for one car, $10 for two or more. There are twenty standard rates, with other special ones for offices and theatres, hotels, stores, colleges, etc., laundries, commercial garages ($30 each) and public toilet rooms ($30 each).

Bills against private dwellings and churches are given a discount of 30%, with a minimum rental of $4. Minimum rental for other buildings, $5. There is also a discount of 5% on all bills for payment before April 1st. Delinquent bills are placed in the hands of the town solicitor for collection, and if they are not paid within three years liens are filed against the delinquent properties. The total of such delinquent bills in January, 1931, was $18,956, an increase of $4,270 over the previous year, or 16.6% of the total rentals for 1931.

Another item of annual expense was flushing sewers. Forty-three days were consumed in flushing 111 miles of sewer in 1930, at a cost of $1,118 for labor and truck, $245 for inspector, $551 for water and $23 for supplies, a total of $1,937, or $17.42 a mile. Cleaning catch basins cost $234. In addition, 158 manhole tops were reset; nine manholes were built in a 1600-foot stretch of sewer which had been built without any; and, when their services were not demanded elsewhere, four men, a truck and sewer cleaning apparatus were used to clean sewers by dragging with a swivel-jawed bucket. During the year 22.64 miles of sewer were cleaned at an average cost of $264 a mile.

Cost of Operating Ottawa, Kans., Sewage Plant

The sewage treatment plant at Ottawa, Kans., was designed to treat 1.2 m. g. d. from 12,000 population, but last year was treating about 0.5 m. .g. d. from 7,000 connected population. The treatment consists of preliminary plain sedimentation, activated sludge and sludge digestion. The plant is located only a few blocks from the business district. The effluent is pumped into the river with a lift varying from 5 ft. to 50 ft.

The primary and secondary settling tanks are equipped with clarifier mechanism and sludge pumps, and the digestion tank with concentrating and scum breaking mechanism. The digestion tank gas is burned under a hot water boiler for raising the temperature of said tank.

The power used for operating the plant is manufactured by the city light department at a cost of about 1 cent per k. w. h. When the plant had been operated for six months it was found that 22,000 k. w. h. had been used for pumping, 12,960 for auxiliaries and 56,703 for aeration; a total of 91,663 k. w. h. Assuming double this for a year gives a cost for current of $1,833.26, of which $1,134.06 is for aeration.

The construction cost of the plant (exclusive of outfall sewer and land) was approximately $87,000, or $7.25 per capita of designed capacity.

The yearly operating cost was: Power $1,833; labor $1,560; extra labor $72; oil and supplies, $50; total $3,515. Adding 10 % for interest and depreciation, or $8,700, gives a total cost $12,215 a year, equivalent to $1.75 per capita of connected population; or $67 per million gallons.

Standards for Manhole Frames and Covers

A CITY of about 500,000 population has estimated that there are at least 100 different types and sizes of manhole frames and covers in its streets; while a single foundry in another city reports that it has about 2000 different sets of patterns for frames and covers, of which nearly 600 are active at the present time.

This condition would seem to be entirely unnecessary, and the American Standards Association has prepared plans for 13 types of frames and 7 types of covers to replace the thousands in use, which it is proposing for adoption as national standards; these plans being sponsored by the American Society of Civil Engineers and the several telephone organizations which are member bodies of the association.

The thirteen types of manhole frames proposed are as follows:

Straight Type Round Base
Flared Type Round Base
Flared Type Square Base—(height 10″)
Flared Type Round Base—Shallow
Flared Type Square Base—Shallow
Flared Type Square Base—(height 7″)
Flared Type Square Base—Light Weight
Straight Type Square Base
Straight Type Round Base—For Inner Cover
Straight Type Square Base—For Inner Cover
Straight Type Round Base—Shallow—Flange Midway Between Top and Bottom—For Inner Cover
Straight Type Square Base—Shallow—Flange Midway Between Top and Bottom—For Inner Cover
Shallow Ring

All types have round openings, with diameters of 22″, 24″, 27″, and 30″; also 33″, 36″ and 42″ where large objects have to be raised or lowered through the opening. But the light-weight type is given an opening in the clear ¾″ greater than the nominal diameter so that a light-weight cover can not be placed by mistake in a heavy-weight frame. The height of frame is 5⅝″, 7″ or 10″ in most cases; with 11″ for the inner cover type of frame.

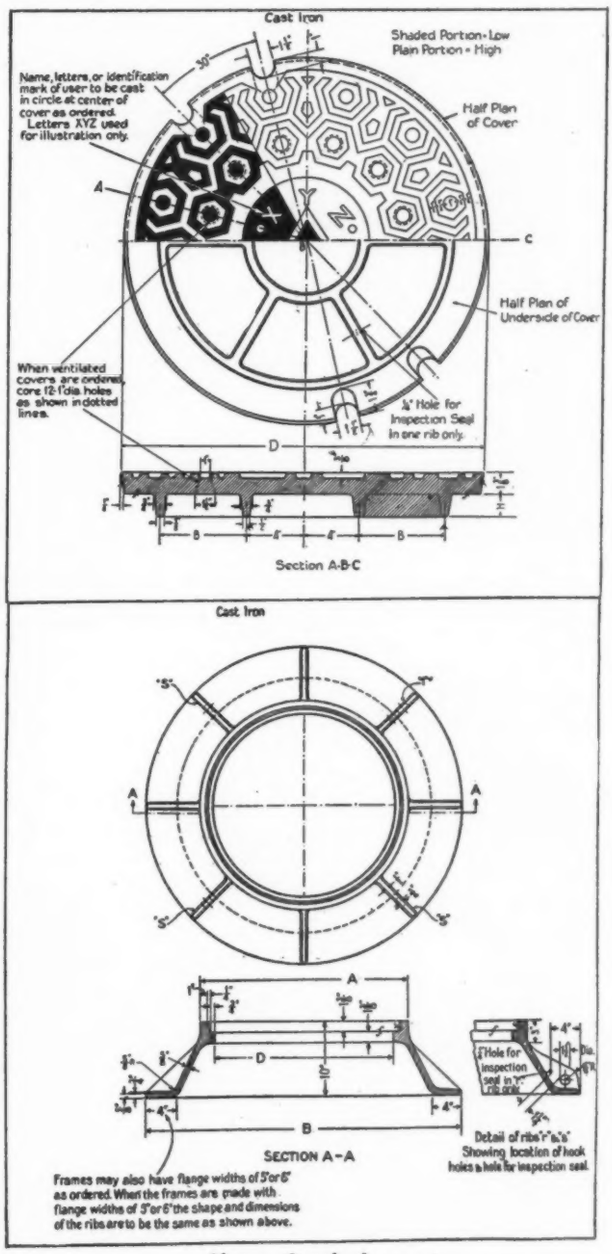
The thickness of wall is generally ⅝ inch, but a light-weight frame with ½ inch wall is provided, and the thickness is made ¾ inch where ribs are omitted (only one type is without ribs). The outside of the wall is free of projecting lips in most of the types, a projection on the inside supporting the lid.

A flange width of 4″ is recommended for most cases, although 5″ or 6″ may be desirable in some cases, as where the masonry opening is larger than the frame opening. All flanges on frames having ribs are ¾″ thick where they join the wall and taper to ⅝″; except for the one light-weight frame where these dimensions are ½″ and ⅜″ respectively; while for frames without ribs the dimensions are 1″ and ¾″. Eight ribs are provided, either ¾″ or 1″ thick where they join the flange, tapering to ½″.

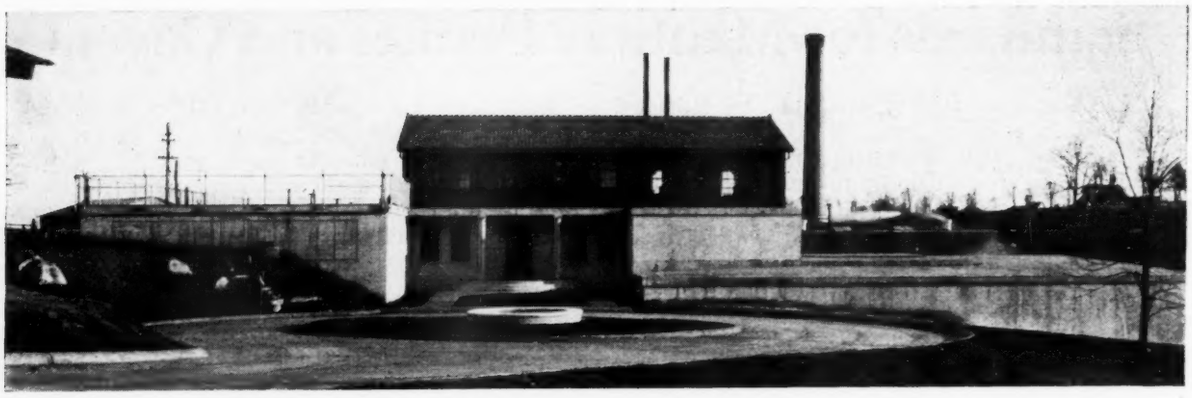
The width of cover seat is made ¾″. The horizontal face of the seat is machined, and the vertical face above the seat is machined to a diameter 1-16 inch greater than the diameter of the cover.

The width of the top of the frame should be not less than 1″, to provide for wear of traffic.

Flat covers are recommended, 1⅜″ thick throughout (except for the ribs), for all cases except when not subjected to vehicular loads, when ¾″ may be used. A combination of circular and radial ribbing is proposed for the under side, the several styles showing, some two and some three circular ribs, and some six and others eight radial ribs. Ventilation holes are optional. In every instance two hook holes, diametrically opposite, are provided for removing covers. The pattern of the top of all covers would be the same, any lettering or distinctive marking being placed in a circular space in the center of the cover.


Cast Iron
Shaded Portion-Low
Plain Portion-High
Name, letters, or identification mark of user to be cast in circle at center of cover as ordered. Letters XYZ used for illustration only.
Half Plan of Cover
Half Plan of Underside of Cover
When ventilated covers are ordered, core 12-1" dia. holes as shown in dotted lines.
¾" Hole for Inspection Seal in one rib only.
Section A-B-C
Cast Iron
SECTION A-A
Detail of ribs "r" & "s" Showing location of hook holes & hole for inspection seal.
Frames may also have flange widths of 5" or 6" as ordered. When the frames are made with flange widths of 5" or 6" the shape and dimensions of the ribs are to be the same as shown above.

Above—Standard cover
Below—Standard frame, flared type, round base



Front view of Murfreesboro filtration plant

Water Works Improvements at Murfreesboro, Tenn.

By C. N. Harrub, B. S.
Member A.S.C.E., Eng. Assoc. of Nashville, A.W.W.A., N.E.W.W.A.

IN 1922 the city of Murfreesboro, Tennessee, purchased the public water supply, which up to that time had been owned by a private company. The old plant consisted of two horizontal return tubular boilers, a Platt Iron Works reciprocating pump, a pressure filter, a small standpipe, and the distribution system. Almost immediately the city began to make improvements and to enlarge the system, installing a new pressure filter and a Murray Iron Works pump driven by a Corliss cross compound engine; and in 1927 a new 150 HP boiler was added.

While the above mentioned additions and improvements helped to some extent, it became apparent to the city officials that some comprehensive plan of improvement must be worked out if the water system was to keep abreast of the demand for service. Accordingly in 1928 the writer's firm was engaged to make investigations with this object in view; and as a result of its report, contracts were let during 1929 covering the following items of construction:

Erection of a concrete gravity type filtration plant, including sedimentation basins and clear water reservoir.

Removal of old boilers and installation of two new ones.

Construction of radial brick chimney.

Erection of new power plant, including the installation of two generators.

Construction of a 500,000-gallon elevated steel tank, and a belt line of 8″ and 12″ pipe to improve the pressure.

Filtration Plant

The filtration plant consists of two sedimentation basins of 125,000 gallons capacity each; four half-million-gallon rapid sand gravity-type filters, and a million-gallon filtered water reservoir. Between the sedimentation basins and the filtered water reservoir is the pump room on the first floor, and the office, laboratory and chemical room on the second floor.

The high-service pumps and the wash-water pump are in the filter building, and the low-service pumps are in the power plant. All pumps are Dayton-Dowd, electrically driven; the wash-water pump having a capacity of 2750 g.p.m., and each of the others 1000 g.p.m.

Filters are equipped with operating tables and hydraulic valves. Equipment was furnished and installed by the Norwood Engineering Company, of Florence, Mass. Wallace & Tiernan dry feed and chlorinating machines were used.

Power Plant

The new power plant was practically built around the old one. The front was extended sixteen feet forward to provide for additional coal storage, and also space for the installation of another generator at some future date. The new machinery consists of two Hedges-Walsh-Widener horizontal return-tube boilers of 150 HP each; a Worthington type N feed-water heater; a new feed-water pump; two 440-volt, 187.5 KVA General Electric generators driven by Skinner Universal Unaflow engines; switchboard; Elliott condenser; and the two low-lift pumps above mentioned.

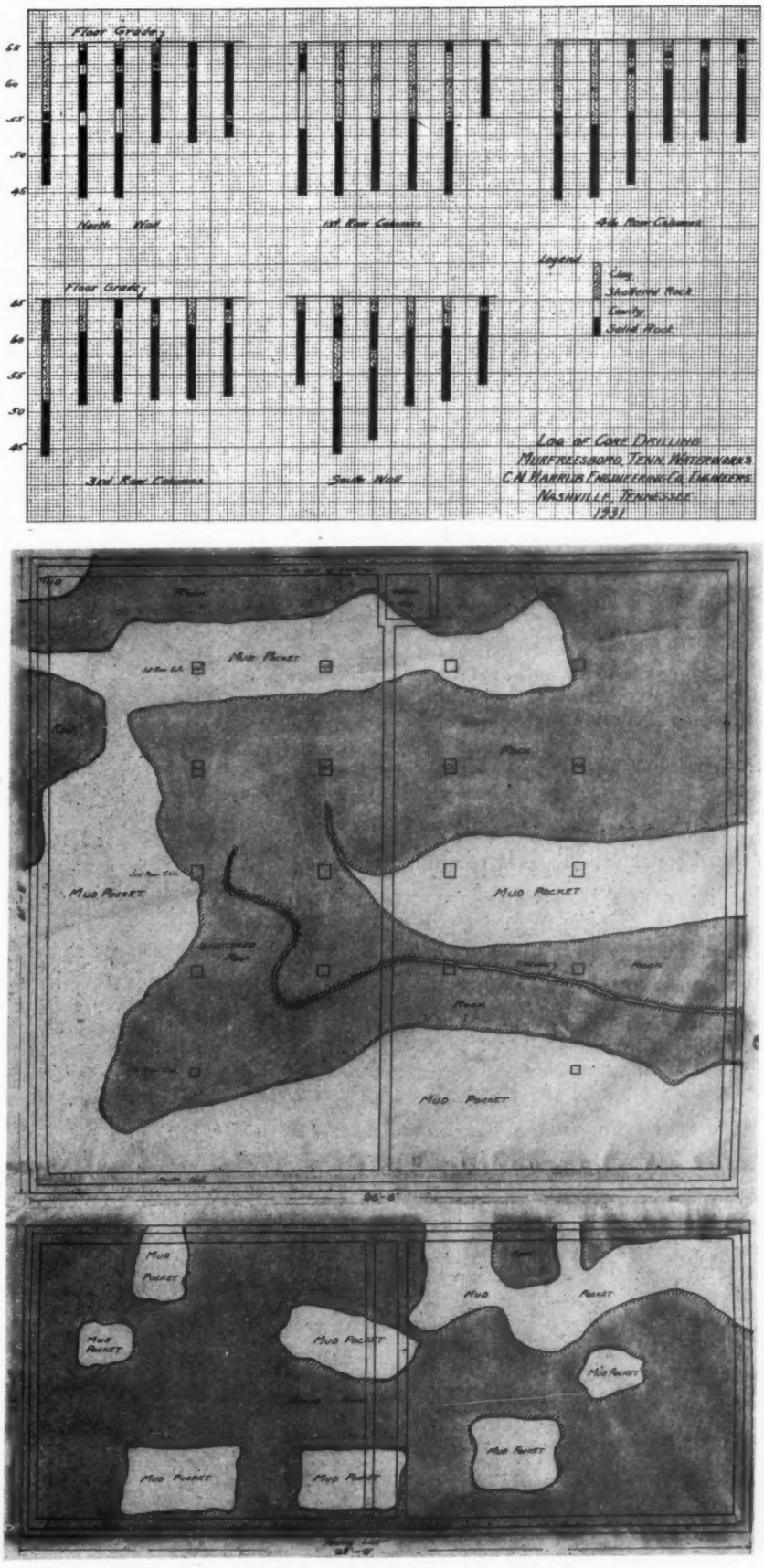
Construction Program

As it was necessary to continue the old filters in operation during construction, work was started at the filtration plant. Previous experience in construction in the city had indicated that solid rock would be encountered before the excavation had reached the elevation fixed upon for the foundations for the sedimentation basins and the filtered water reservoir. Outcropping rock at the site also indicated this. However, instead of solid rock, a cavernous condition was found some distance above grade, and as excavation continued some of these caverns became wider and more extensive, developing into channels, evidently produced by the flow of water at some remote time. These channels varied in width and depth from two

to ten feet or more, and were filled with a soft clay mud. In the filtered water reservoir area they were below ground water level, consequently were constantly wet, and so soft in many places that a one-half-inch rod could easily be forced to a depth of ten feet with one hand. Unfortunately the widest and deepest of these mud pockets lay directly in the line selected for one of the rows of columns supporting the filters.

As such a condition was entirely unsatisfactory for a foundation, it was deemed necessary to make further studies before construction was started. As conditions appeared to get worse the deeper the excavation went, instructions were issued to stop excavation at about one and one-half feet above grade. Attempts were made to determine the area and depth of the mud pockets, but these investigations gave no assurance of a satisfactory foundation. Consequently we decided to core drill the area. Cores were taken at all column sites and at the side walls opposite the ends of the column rows. Drilling was carried to a depth of twenty feet below the existing rock surface, unless ten feet of solid rock was encountered at less depth. The twenty foot depth was decided upon, so as to get below small cavities, and into solid rock if possible. This depth proved to be sufficient, for in no case where the full twenty foot depth was drilled was there less than eight feet of solid rock at the bottom and in a majority of the holes ten feet of solid rock was found in from ten to fifteen feet of depth. Sketches showing the location and approximate areas of the mud pockets in the two basin areas are shown in the accompanying illustrations.

As the results of this work indicated a satisfactory foundation at irregular depths below the originally contemplated grade, but no possibility of obtaining a continuous rock base at that grade, it was decided not to continue excavation over the whole area, but to raise the entire structure to fit the excavation as



Above—Filtered water reservoir. Below—Sedimentation basin

made, confining further excavation to pier locations. Accordingly the bottom of the structure was redesigned to be carried on columns and girders instead of on solid rock, as had been originally anticipated. Pits were excavated at column sites, all loose rock and thin layers being removed down to the ten foot layer of rock. Columns were built resting on this solid rock, and girders put under the floor to span the soft mud pockets. In one section where solid rock was only about three feet below floor grade, a continuous wall was carried down to the rock under the floor, without columns.

The core drilling was done by the Mott Core Drilling Company of Huntington, W. Va., at a cost of approximately $2,200. The performance of this work delayed construction about two months, but it was considered time and money well spent, as it removed all doubt of the ability of the foundation to carry the load.

Distribution System

In addition to the complete rebuilding of the power and filtration plants, the distribution system was improved by the construction of an elevated steel tank and a feeder main. The tank has an ellipsoidal bottom and a capacity of 500,000 gallons. The tower is one hundred feet high to the bottom of the tank.

The feeder main consists of a 12″ line from the filtration plant to the elevated tank, approximately a mile away, and an 8″ line around the other three sides of a rectangle, so as to form a belt around the city. The feeder main is connected to all old lines which it intersects. The result of this elevated tank and large main has been to nearly double the pressure in the business section of the city. All water leaving the plant is measured by a Builders Iron Foundry Venturi meter with Type M recording instrument.

Cost

The total cost of the improvements was $266,412.09, which was distributed as follows:

Filtration plant	$121,237.97
Power house and equipment	74,953.95
Elevated storage tank	26,574.83
Distribution system	43,645.34
	$266,512.09

The total engineering costs, including surveys, design, supervision of construction and inspection were $18,897.86 or 7.18% of the cost exclusive of cost of real estate.

Design and supervision of construction was by the writer's firm, The C. N. Harrub Engineering Company of Nashville, Tennessee, with Edward H. Deets as resident engineer in charge. The plant was constructed under contract by the following concerns:

General contract, including filtration plant complete, power plant building and pipe lines—V. B. Higgins & Company of Charlotte, N. C.

Power plant equipment, including boilers, feed water heater, generator sets and switch-board and pumps—The Nashville Machine & Supply Company, of Nashville Tennessee.

Chimney—Alphons Custodis Chimney Company of Atlanta, Georgia.

Elevated steel tank—Chicago Bridge & Iron Works, Chicago, Illinois.

Chicago's New Residential Street Lighting

CHICAGO has recently completed the installation of 250 miles of residential street lighting in which ornamental beauty is combined with efficiency, and the illumination is increased from an average of 4,200 lumens per block to 12,500. These lights were placed in sections which had had inadequate gas or oil lighting or no lighting at all.

The installation included 8,000 cast-iron standards and fittings, 2,500,000 feet of duct line, 400 transformers for 180 manholes, 225,000 feet of 2-inch pipe laterals, 3,000,000 feet of single conductor and 100,000 feet of 4, 8 and 12-conductor cables. It is said to be the largest and most comprehensive street lighting installation made during the year 1931.

A street showing one of the lighting standards of the new street lighting system of Chicago.

The lamp posts are 11 feet high, mounted on separate concrete foundations and equipped at the top with series receptacles and sockets housed in ornamental glass and post-top lamp fixtures. These posts are spaced five to the standard 660-foot block, two being placed at each street intersection on diagonal corners and the others in staggered relations, providing a lamp at each intersection of street and alley. The standards, including capitals, sockets on aluminum canopies, were manufactured by the Westinghouse Electric and Mf'g Company.

Electrical energy is obtained from the Sanitary District of Chicago and is brought into the various municipal substations, from which the lighting system is fed by circuits of 5050 volt, single phase, 60 cycle alternating current of a constant value of 6.6 or 10 amperes. This energy is conveyed over multi-conductor lead-covered cables occupying underground conduit lines to the points of connection with primary 5000-volt armored cables, which are laid in parkways generally adjacent to the curb and pass through iron pipes or lateral conduits where beneath the surface of the streets, alleys, driveways and sidewalks.

The Chicago street lighting system now covers 3600 lineal miles, 210 square miles, with a total of 95,000 lights ranging from 1000 lumens to 10,000 lumens, and is the largest municipal street lighting system in the world.

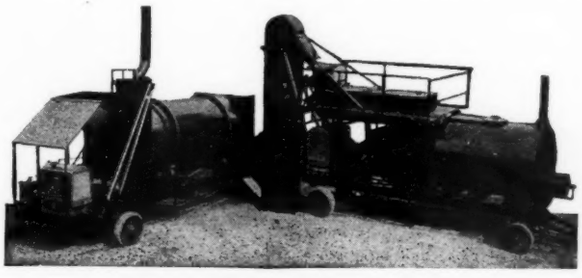
Equipment for Constructing and Maintaining Low-Cost Road Surfaces

IN the February issue we abstracted a part of the excellent report of the joint committee on Equipment for Construction and Maintenance of Low-Cost Road Surfaces which that committee had submitted to the American Road Builders' Association. An abstract of the remainder is given herewith.

Equipment for Bituminous Plant Mix

The principal operations for constructing road surfaces of plant mix include:

Proportioning of aggregates and bitumen, usually by weight in bins, or *hoppers* equipped with *scales*. (Some plants have additional equipment for *drying* aggregates.) Mixing or coating aggregates with bitumen in *pug mills*, or *drum mixers; continuous type mixers, vats* or tanks in which aggregates are immersed for coating with bitumen are recent innovations. *Trucks* are commonly used for hauling plant mixtures from plant to road; *spreader boxes* are used to a limited extent. (Recently developed mixers deposit the mixed materials directly on the road, similar to the action of the chute once used on concrete



Chausse Bituminous Pre-mixing Plant

pavers). Power-driven *blade graders* are commonly used to spread and shape cold-lay mixtures which have been placed in windrows, sometimes augmented or replaced by heavy *drags* or by hand spreading. Two types of bituminous pavers, besides mixing and dumping the surfacing mixtures, have also spreading devices. Power *rollers* are commonly used for compaction, especially when side forms are not used. *Finishing machines* are satisfactory for striking off and for light compaction, but power rollers should follow them for best results.

Comments on equipment for this type are: That there is need for equipment which will lay plant mix at cost about equal to that of road mixes. That initial compaction of the finer aggregate types may be done successfully by track-type tractors, followed by power rollers for final compaction. That the development of mixing plants and plant mixes is attracting more than usual interest on the part of highway engineers, bitumen producers, equipment manufacturers and a few contractors.

Equipment for Maintenance

Maintenance operations, as designated in this report, include the principal work done to the original surface course for the purpose of keeping it in serviceable condition. Maintenance equipment of various types should be capable of satisfactorily performing the following operations:

Scarifying and reshaping.
Blading and dragging.
Patching and compacting.
Adding new materials which are similar to those in the existing surface.

One or several of these operations are commonly necessary on any type of low-cost road surface. One type of equipment may be used to perform several maintenance operations.

For Untreated Surfaces: The operations and equipment commonly used are:

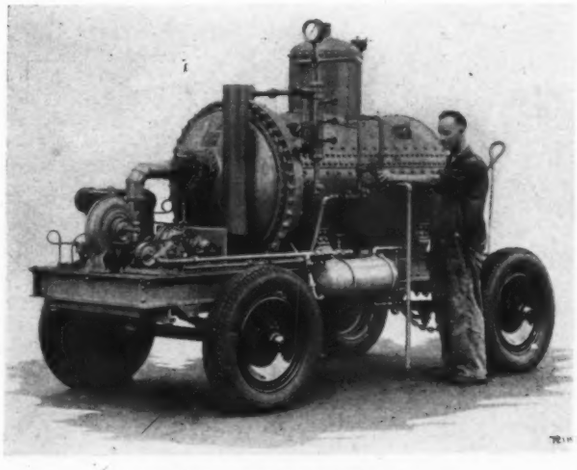
1. Scarifying and reshaping because of high crowns, large protruding stone or because of corrugations. Scarifying is accomplished by *scarifiers* attached to graders, *rollers* or *tractors*. Reshaping by *blade grader* is common practice. Light, portable equipment for separating out oversize aggregate as well as for crushing it is in demand.

2. Blading and dragging. Light *road machines, patrol graders, spring blades* attached to trucks and drags are used for daily and routine maintenance, especially in dry weather. Heavier equipment is used when the road is moist and when irregularities in the surface cannot be removed by the lighter equipment.

3. Patching of untreated surfaces is resorted to during dry weather and is usually done by hand tools.

4. Addition of new materials is the most expensive maintenance item. It is usually performed by the same methods and with materials similar to those used in constructing the original surface. An exception is the addition of a fine surface mulch of gravel to well-compacted stone macadam; this mulch is later maintained by light dragging.

For Non-bituminous Surface: Except for machinery for distributing calcium chloride or lignin binder (already described), operation and equipment are the same as for untreated surfaces.

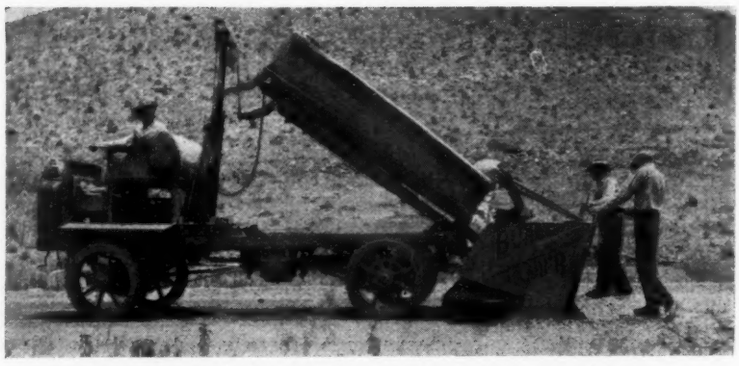


Cleaver Tank Car Heater

For Bituminous Surfaces: The operations and equipment commonly used are:

Scarifying and reshaping (more common on the graded and fine aggregate types than on the coarse aggregate types). No unusual equipment has been developed; scarifying is done by light or heavy-duty equipment as required by the degree of compaction and depth of surface. Remixing is done by *harrows* and spreading by *graders.*

Patching of shallow holes and small areas is done by skin patching and consists of cleaning the area with *brooms* followed by alternate applications of bitumen and aggregate.



Stone-spreader, surface treatment in Cochese County, Arizona.

Large holes are patched with pre-mixtures of bitumen and aggregate. These are mixed in any available roadside plant or at commercial plants; they are also mixed by hand tools. Almost any type of plant seems to be more satisfactory than hand mixing when a considerable mileage must be maintained under normal traffic of 500 or more vehicles per day.

Retreatments or seal coats are usual as maintenance operations. They consist of applying bitumen from *power distributors* and the application of aggregates, preferably from *chip spreaders.*

Recommendations

The committee makes several recommendations on equipment and methods, based on the extensive data collected.

Equipment for *untreated surfaces* is reported generally satisfactory—few recent developments and little demand for any except for special rollers for obtaining dense and quick compaction of untreated surfaces.

Blading and dragging with equipment now available gives very easy riding surfaces on all *low-cost* types. Rotary broom and blower excellent for cleaning surfaces before bitumen treatment.

For hauling *bitumen,* use of auxiliary tank trucks is growing. There is a growing tendency to compact all bituminous surfaces by rollers; initial compaction by tractor is advantageous when the mixture lacks sufficient stability to carry standard type rollers.

Chip and stone *spreaders* are popular.

Equipment for *plant-mix* concrete, its suitability for contract work, and the desirability and economies of such concrete as compared to road-mix, are matters of especial interest. The committee suggests that it be continued to make a study of the relative merits and suitability of equipment for road mix and plant mix.

Among *equipment needs* are named apparatus which, for road mix types, "will more quickly and uniformly coat the aggregates with bitumen, will be effective for depths of materials greater than 2½ inches loose measure, and will not push the mixtures outside the width proposed for finished surface."

Also improvements for bituminous distributors such that the application of the bitumen can be started and stopped more cleanly and be made at a high rate for thicker types of surfacing.

While developments in methods and equipment are desirable, they should not result in changing low-cost surfaces to high-cost ones because of exacting requirements and expensive refinements.

Recent type of sand spreader

Sewage Plant at Low Cost

Hopeville, Ga., population 565, placed in operation in 1931 a sewage treatment plant consisting of bar screen, Imhoff tank, dosing tank, sprinkling filter and sludge drying bed, calculated to serve an ultimate population of 700, which cost the city only $7,628.16. The cost would have been about double, but the county furnished convict labor for excavation, pipe laying, clearing the grounds and pouring concrete and also furnished the crushed stone.

The stream receiving the effluent was so small that complete treatment was required; much more than was furnished by the septic tank which the new plant replaces. The plant is operated by the personnel of the water and sewage department, who make operation tests and keep records of the operation. The plant is producing a satisfactory effluent.

Surface-Treating Gravel Streets in Newport News

By A. R. Taylor
Tarmac Dept., Koppers Products Co.

CONFRONTED with the necessity of improving the surface of as many miles of streets as possible with the limited funds at its command, the city of Newport News, Va. (population about 35,000), after investigating various kinds of road surfacing, decided upon 6-inch compacted gravel, surface-treated with Tarmac, which could be laid for less than $1.00 a square yard. A good grade of gravel, known locally as Powell Creek gravel, was available, which was low in clay content, and had given excellent results when used in such construction. It was concluded that construction of curb and gutter would give a more satisfactory street than if they were omitted.

In the summer and fall of 1925 Joseph Biggens, city manager, began grading and graveling several streets. The gravel was laid loose to a depth of 7 inches, compacting to about 5 inches, depending somewhat on the condition of the subgrade. The gravel, after being spread on the surface of the street, was bladed with road machines and dragged in order to obtain uniform, smooth riding surfaces. These streets were allowed to go through the winter in order to permit the gravel to weather, as it had been found that such streets gave better results when allowed to go through one winter season before being surface treated. In the spring, the streets were re-shaped and surface treated.

The surface treatment consisted of sweeping all loose and caked dirt from the surface of the streets, and priming with about one-third gallon of Tarmac P per square yard, applied by pressure distributor at atmospheric temperature. From 10 to 24 hours later this prime coat was followed by an application of Tarmac A, at the rate of 1/3 gallon per square yard, applied at 180° F., after which it was immediately covered with 35 to 40 pounds of clean stone chips, ranging in size from 1″ to ¼″. The surface was then rolled with a five-ton, three-wheel roller.

This double treatment combines the advantages that are obtained by the use of both cold and hot application tar, in that the prime coat penetrates into the gravel surface, binding together the gravel particles penetrated, also forming a bond for the hot tar which holds a larger and greater amount of cover material, making the surface treatment an integral part of the road, and giving a smooth, durable, non-skid surface.

The first year the city constructed about 50,000 square yards of this type of street, which proved so satisfactory that they have continued to build a few additional streets each year, until today they have over 200,000 square yards of gravel streets surface-treated as described. These streets cost approximately $0.85 per square yard, which was under the original estimated cost.

The year following construction, these streets are lightly retreated with approximately one-quarter gallon of Tarmac P and covered with about 22 pounds of stone chips per square yard, the cost of this being approximately 9 cents a square yard. Very little maintenance work is required and no additional retreatments have been necessary in spite of the fact that some of these streets are six years old.

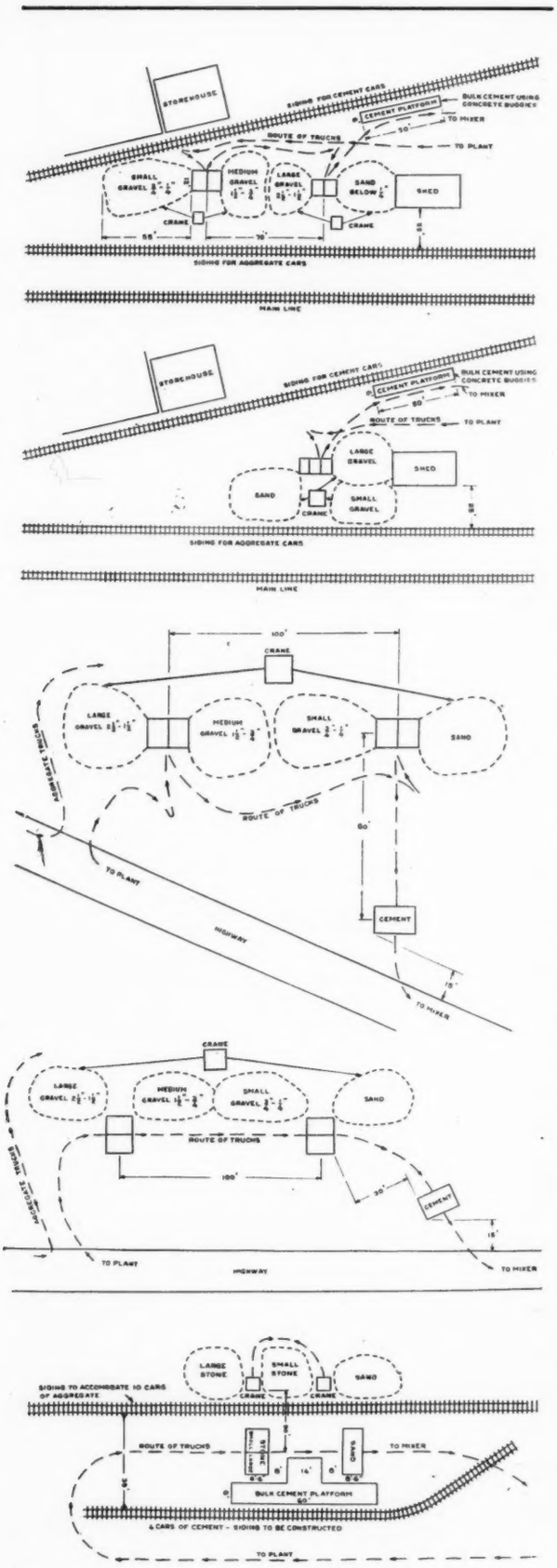
Street in Newport News paved with surface-treated gravel

Amount of Sewage From Schools and Institutions

In a discussion of this question by the Maryland-Delaware Water and Sewerage Association, Dr. Willem Rudolfs (of New Jersey) said:

"We have for the last year been measuring, accurately, two schools, one of about 125 pupils and the other about 240 pupils. We find that the flow in the two schools varies between 8 and 15 gallons per pupil. We have also had occasion to measure seven institutional flows. We find that the institutional flows are considerably higher than the average flow from a town. For an insane hospital with about 4500 inmates the flow was about 200 gallons per patient. For a tuberculosis hospital, the flow was 175 gallons per person. For smaller and other institutions, they all run between 175 and one ran up as high as 290 gallons per person. We also had accurate flow measurements over a period of three months from an industry employing 2300 people. We find that an average flow from the industry, separate from any waste, varies between 32 and 40 gallons per person working in the industry."

Robert B. Morse, chief engineer of the Washington Suburban Sanitary District, said that they found public schools in the district to use 5 to 10 gallons per capita. When designing sewers for the schools it should be remembered that, although the amount is small, it is discharged during a very few hours per day. In schools with resident pupils the per capita sewage may run even higher than for a small town of equivalent population.



Figs. 1 to 5 are shown above in series, No. 1 at the top and No. 5 at the bottom

Effect of Plant Layout on Cost of Concrete Construction

TWO Wisconsin projects of concrete road construction, No. 2916, which was 9.88 miles long, and No. 2926, which was 11.27 miles long, have been studied by the Bureau of Public Roads and of the several features of construction included in this study one was that of the plant layout.

The projects called for a mixture of three sizes of coarse aggregate, and the plants had to be planned accordingly. Figure 1 shows the plant layout and set-up for project 2916. It is obvious that a very crowded condition existed. In fact, the plant set-up was such that trucks lost an average of 2 minutes per load more than necessary for a typical set-up, a condition which required the use of one and sometimes two trucks more than would have been used normally. An extra crane was also required. The materials were delivered by rail.

Figure 2 is the same plant site but with equipment and stock-piles planned for handling two sizes of coarse aggregate. In so far as the cost of handling the aggregates and batching is concerned, this set-up would not result in any more cost for handling the two sizes than if only one size of coarse aggregate were used.

Figure 3 is the plant layout for one of the set-ups on project 2926, showing the number of turns and maneuvers that the trucks had to make in order to obtain a load. Figure 4 shows the same set-up but with a recommended change that could be used on similar jobs. Turning time for the trucks would then be eliminated. If only two sizes of coarse aggregate had been specified, a 3-compartment bin could have been used which would have required but one stop for the trucks. This would have been a most economical set-up and would still have utilized the advantage of multiple-sized aggregates. On this job the material was delivered by truck from a local pit and only one crane was necessary to supply the mixer demand for aggregates. This crane supplied material for the mixer when a 33-cubic-foot batch and a 50-second mixing time were used. An average of fifty-five 33-cubic-foot batches an hour were taken care of by the crane. This means that the crane handled an average of 238,931 pounds of sand and gravel, or about 80 cubic yards of material, per hour.

Figure 5 shows a set-up observed during the summer of 1930 handled by one crane and utilizing a method of straight-line loading. Bulk cement was placed in the batch between the stone and sand, eliminating the time usually required for covering the cement. This method proved very satisfactory. Some engineers, however, prefer to have the order of loading changed to second-size aggregate, sand, cement, and then coarse aggregate.

Incidentally, this contractor was using sack cement but obtained permission to try bulk cement, which resulted in a saving of 11 cents on each barrel of cement.

The plant and truck economy of two sizes of coarse aggregate as compared to three sizes is apparent from the above.

THE EDITOR'S PAGE

1932 Engineering

Changes which affect directly every one in the public work field are taking place. Engineers are finding that they must think and plan in terms of 1932 conditions—mental and financial. Lower prices on construction work alone will not suffice to induce the average citizen or the average elected official to spend more money. New ideas, newer methods, and better design, coupled with sound engineering and a full appreciation of the mental reactions of those whom he serves is the need of the 1932 engineer. Now is the time, more than ever, when he will have to demonstrate his ability to make two yards of pavement, or two filters, or two settling tanks grow where in other years his brother engineer made but one grow. And, in addition, he's going to have to prove that two are needed.

Many engineers are awake to these new conditions. With their aid, PUBLIC WORKS will present in forthcoming issues some of the developments that have already taken place, and will point out the need for meeting the problems of 1932 engineering, and how to do so.

Excess Capacity for Future Requirements

In designing many kinds of public work, probably a greater reduction in cost can be made in limiting excess capacity than in any other way. It is of course necessary to design a water supply or other public utility system with a greater capacity than that required to meet today's demands, else construction for additional capacity must be begun as soon as the original plant is completed. But for how much greater capacity is a nice point to decide.

It has been more or less common practice to design water works, sewers and other utilities for requirements of thirty to fifty years ahead, or about double or triple the present requirements. But we believe that in many cases it would be better to anticipate only five to twenty years, and at that time increase the capacity by new construction. Theoretically this might give a greater ultimate cost; but the difference between the cost of twenty-year and fifty-year anticipation, with compound interest at five percent, would in twenty years amount to a total not so very far short of the cost of duplicating the original construction. And just now, especially, an immediate saving of a thousand dollars may be thought preferable to a saving of a hundred or two twenty years hence.

Again, no one can tell with any certainty what will be the requirements fifty years hence—they may never exceed those calculated for the next twenty years. Or in twenty years it may be found that a duplicate structure in a new location would be preferable, or one built to meet changed conditions.

Even more important in the case of a purification or treatment plant, twenty years or even five years from now may find the plant less efficient or more expensive or otherwise less acceptable than another type developed meantime, so that it may prove to have been a mistake, both financial and technical, to have provided the excess capacity; especially as such plants are built in units which can be duplicated easily at little cost. Therefore, for such plants a three-year or five-year excess may be the wisest decision.

But this means more careful use of expert engineering judgment. If a plant is to be built of double the estimated present requirements, a mistake of twenty-five percent in such estimate is of no immediate importance, and when discovered (if ever), the engineer may be beyond the reach of human criticism.

"1932 engineering" can save considerable sums to the taxpayers, but can do so wisely only if it uses care, common sense and sound judgment based upon a most thorough investigation of facts and conditions.

Don't Save the Flowers for the Funeral

The borough of Hanover, Penn., is under council-manager government. In its report for 1931, the fourth year of this system of government, the council makes the following statement:

> The members of the Borough Council, individually and collectively, on their own initiative, desire to take advantage of space in this report to embody their own expression of recognition and appreciation of work and services performed in their behalf.
>
> We consider that the borough was fortunate in adopting managership form of government at the time it did and is particularly fortunate in securing the services of C. A. Eckbert. He came here at a time when the borough was ready to launch upon a series of improvements involving large sums of money in the extension of sewers, building of the sewage disposal plant, and the opening, paving and repair of highways. Mr. Eckbert showed not only his ability, but also the ambition and energy to carry through the work to a successful conclusion. He has worked incessantly, day and night, without vacation, and his energy has inspired those employed under him. He has gathered about him workmen whom he has trained so that nearly every phase of borough work can be undertaken without the letting of contracts or the employment of experts. He has introduced many innovations which have been of great convenience to our citizens. He has been loyal to council, to burgess and officers, and regardless of personalities he has carried through his program and established his budget without placing any new financial burdens upon the borough. At the same time the borough has been able to keep a full crew of men at work and maintain and promote every phase of borough activities in all seasons to the general satisfaction of the public.

Public service is not always a thankless job, but it is too seldom that satisfaction with service rendered is expressed, even though it may be felt.

Higher Gasoline Taxes

Many proposals to increase gasoline taxes are being made, with a view to diverting the funds from road-building purposes. But proponents of such taxes should realize that higher gasoline taxes do not produce greater yields—if as great. Omitting any consideration of the heavy burden that is placed upon the oil and automobile industries, experience has shown that higher gasoline taxes so encourage tax evasion that the result is not higher yields but increased activity by gasoline bootleggers and racketeers at the expense of honest gasoline dealers and producers, and with a reduction in anticipated revenues.

In an early issue we will publish an article giving some interesting facts on the subject.

LEGAL DECISIONS

Concerning Matters Connected With City and Village Streets and Pavements

By John Simpson

Bond to Maintain Paving in Repair

A contractor's bond, under the Iowa statute, to maintain street paving in good repair for five years, does not, the Iowa Supreme Court holds, Charles City v. Rasmussen, 224 N. W. 589, limit liability to defects due to defective workmanship and material, but includes whatever holes, cracks, or other defects require repairs, produced by the ordinary use of the street, necessitating repairs or replacements. The contract in this case provided that the contractor guaranteed that the improvement "shall be and remain in first class condition of true and even surface" for five years.

What Street Improvement Ordinance May Embrace

Under a city charter authorizing the assessment of one third of the cost of a street improvement to be assessed against each of the owners of property on each side of the street and by an appropriation from the city treasury, the Georgia Supreme Court, Campbell v. City of Covington, 155 S. C. 200, held it to be competent for the municipal authorities, in the improvement of streets, to provide in a single ordinance for the pavement of several streets, a single street, or a portion of the street, and to include the intersection of streets, and to charge the same against the property of abutting lot owners; provided that in making the apportionment of the cost of such improvement, where the front foot rule is adopted, the assessment is made in such manner as to impose upon the respective lot owners their proportionate share of the entire cost estimated according to the width of the respective streets upon which their lots abut.

Separate Contracts for Single Improvement

Where an ordinance provides for the improvement of a street from one point to another, the Kentucky Court of Appeals holds, Moss v. Andrews Asphalt Paving Co., 17 S. W. (2d) 255, that the city council in letting the contracts for the work, may split the authorized improvement into several projects and let separate contracts therefor. A contract was not invalid because the improvement stopped some 10 feet short of one of the sections, where it was not shown that the street was not constructed according to the plans and specifications. There is no real distinction between the right to determine what part of the width of a street shall be improved and what part of the length shall. Under section 3454 of the Kentucky Statutes, the city council has the right to determine what streets or parts thereof shall be improved, and also the extent and character of the improvement.

Excavating Contract Based on City Engineer's Computation

A contract to do excavating and filling on certain streets was based upon the number of cubic yards of cut and fill as computed by the city engineer. The contractor did the work and was paid the price. Claiming mistake, he sought reformation of the contract and payment. There were admittedly errors in the engineer's computation of 1,673 yards and plaintiff contended another error of 1,844 yards, making 3,517 yards in all. The Michigan Supreme Court held, Degood v. Gillard, 251 Mich. 85, 231 N. W. 102, that, although plaintiff made a mistake in accepting the engineer's computation as a basis of the contract, it was his mistake, and not a mutual mistake, hence there could be no reformation, there being no fraud, concealment, or misrepresentation on the part of the other party to the contract.

Competitive Bidding for Improvement Contract

Contracts for the furnishing and application to the wearing surface of city streets of bituminous oil were entered into without submission to competitive bidding. The contractor and his assignee sought to recover from the city the contract price for such repairs or the reasonable value of material and labor funished. The Iowa statute is peremptory that, "All contracts for the construction or repair of street improvements and for sewers be let in the name of the city to the lowest bidder by sealed proposals upon giving" prescribed notice. The Iowa Supreme Court, Johnson County Sav. Bank v. City of Creston, 231 N. W. 705, holds that this statute is a prohibition upon letting such contracts in any other mode. While the statute is not that the repairs shall be by contract, yet the city having undertaken to have them made by contract was required to let the contract on competitive bidding. It is a general principle that a municipal contract entered into in violation of a mandatory statute, or a contract in opposition to public policy, is not merely voidable but void, and that no contract for services rendered or goods furnished pursuant thereto can be implied, nor may the acceptance of benefits thereunder be made the basis of a liability by estoppel.

All persons dealing with a municipal corporation are charged with notice of the limitations upon its power. Those limitations may not be exceeded, defeated, evaded or nullified under guise of implying a contract. A municipal contract let without competitive bidding, when the statute requires competitive bidding, is void, and no recovery may be had either upon the purported express contract or upon an implied contract to pay the reasonable value of the services or material furnished thereunder.

The court could not suspend or override a positive statute to confer upon a municipal corporation power which the Legislature withholds from it. Where a contract is void at law for want of power to make it, a court of equity has no jurisdiction to enforce such contract, or in the absence of fraud, accident or mistake to so modify it as to make it legal and then enforce it. Decree for defendants was therefore affirmed, three justices dissenting.

SALVAGE YOUR WORN PAVEMENTS by RESURFACING WITH BRICK

NO matter what type of "worn" pavement you may be concerned with, it can very likely be resurfaced with brick.

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Brick pavements *do* give service. The U. S. Bureau of Public Roads reports brick as having the lowest maintenance cost in its Chevy Chase experimental road. Cities keeping accurate cost records report likewise.

Brick pavements resist weather as well as traffic wear. For this reason many such pavements are now giving good service after thirty or forty-odd years.

The National Paving Brick Association, 1245 National Press Building, Washington, D. C., will gladly supply additional information on brick resurfacing to those requesting it.

DON'T DISTURB THE SUBGRADE—RESURFACE WITH BRICK

For latest catalogs—consult the *classified* INDUSTRIAL LITERATURE section, beginning on page 63

Projection Method of Designing Street Intersections

By D. Y. Bate

Junior Civil Engineer, City of Los Angeles, California

This is one of a series of articles by Mr. Bate (and others) devoted to the solution of practical field and office problems of city engineering. Readers are invited to contribute short cuts, time saving methods and interesting solutions to this series.

IN this method of solving the problems encountered in the design of smooth riding intersection the curb and flow line (gutter) grades are established on your profile in the usual way and the elevations of A, B, C, D, E and F placed on your work diagram.

The elevations H, G and M are next established by taking the gutter elevations on each side of the street and adding the height of crown to the mean of these.

Calculate the length of the line H. G. As noted on the diagram, all parallel lines are concentric and all points are radial.

On your cross-section paper in a convenient position place a dot to denote the elevation at H, then the location of G is established by measuring the length H. G on the cross-section paper and placing a dot at the proper elevation of G.

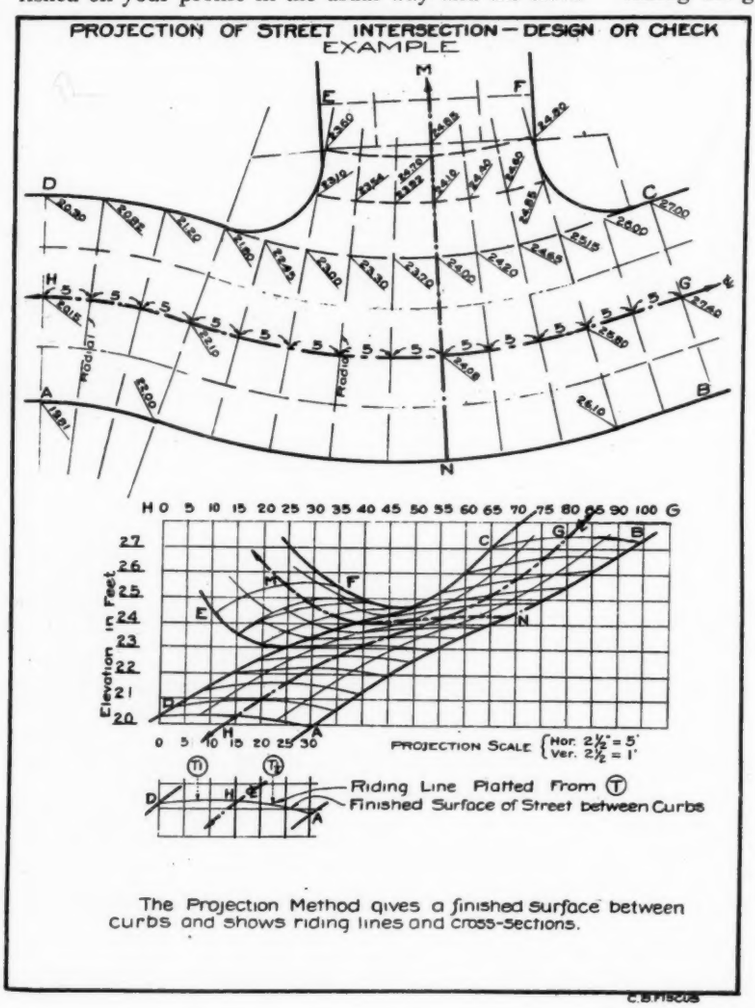
A, D, B and C are next located by elevation and ½ the street width distant from H and G respectively.

Using a smooth, thin, steel spline, connect A B, G H and D C, being sure to take into consideration the approaching grades already established and having no change in grade of more than 1.25% where adjacent grades are more than 5%, reducing your change proportionally for adjacent grades under 5%. Bear in mind that these elevations you establish are represented on the ground by single stakes and the constructor will connect them by a series of straight lines, so "do not be too Scotch" in giving elevations if you want the best results. The line M N is established, or rather determined, by the elevation at M and a smooth line crossing those already established. The light quarter lines are inserted as a check, as it is along them that a car usually rides.

Care should be exercised in establishing the line H. G, as it usually marks the location of an expansion joint and sufficient elevations should be given to completely control the placing and grade of the header board when set for pavement construction.

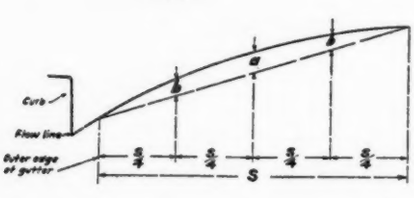
The T sections control the shape of the section, as the tamping template is set according to it.

The accompanying table of T sections is self-explanatory.


PROJECTION OF STREET INTERSECTION—DESIGN OR CHECK
EXAMPLE
Elevation in Feet
PROJECTION SCALE {Hor. 2½" = 5' Ver. 2½ = 1'
Riding Line Platted From Ⓣ
Finished Surface of Street between Curbs
The Projection Method gives a finished surface between curbs and shows riding lines and cross-sections.
C. B. FISCUS

T SECTIONS

DETAIL



If no masonry gutter exists and none is to be constructed the section shall begin at the curb

Values of 'a' and 'b' are in inches

T	a	b
0	0	0
½	½	⅜
1	1	¾
1½	1½	1⅛
2	2	1½
2½	2½	1⅞
3	3	2¼
3½	3½	2⅝
4	4	3
4½	4½	3⅜
5	5	3¾
5½	5½	4⅛
6	6	4½

HIGHWAYS

and

PAVEMENTS

Handling Larger Batches in 27E Paving Mixers

IS it possible and economical to mix batches larger than 27 cubic feet in a 27E paver and obtain as good a concrete as with the smaller batch? And how much larger?

From an extensive study of this which it has made, the Bureau of Public Roads reports that the following conclusions seem reasonably clear:

1. The uniformity of the mixing and the resulting strength of the concrete are equally good for 35-cubic-foot batches as for 27-cubic-foot batches when mixed for 60 seconds.

2. The uniformity of the mixing and the resulting strength of the concrete are equally good for a 30 or 33 cubic-foot batch when mixed for 50 seconds as when mixed for 80 seconds.

3. Under present actual job conditions and customary auxiliary equipment, the most economical batch for the 27E paver seems to be 33 cubic feet with a mixing time of 50 seconds for all solid materials.

4. The large-sized batches, up to 35 cubic feet, and on grades less than 6 per cent, did not cause spillage, leakage, or clogging of either the old or the new pavers, and may be advisable when a mixing time longer than 50 seconds is required.

5. The mixers did not show any signs of breakage related to overloading from using the larger-sized batches.

6. Practically no increase in the present standard auxiliary equipment or labor set-up, nor any change in this equipment or labor set-up, is necessary to use a 33-cubic-foot batch mixed 50 seconds.

The studies were made on three jobs, two in Wisconsin state-aid roads, 20 feet wide and 9-6.5-9 inches thick, each job about 10 miles long; the third a federal-aid road in Arkansas, 18 feet wide and 9-6-9 inches thicks, about 17 miles long. Gravel and sand were used on the Wisconsin jobs, with three sizes of coarse aggregate; and sand and two sizes of crushed trap rock on the Arkansas job.

Bids were asked on the basis of batches of 27, 30, 33 and 35 cubic feet in the Wisconsin jobs, and the successful contractors bid as follows:

	Job No. 1	Job No. 2
For 27 cu. ft.	$0.97	$1.04
For 30 cu. ft.	.94	.99
For 33 cu. ft.	.93	.97
For 35 cu. ft.	.93	.98

Previous to this no batches larger than 30 cu. ft. had been allowed in Wisconsin and bids on the larger batches were probably largely guesses.

Mixers of 1927 models were used by both Wisconsin contractors at first. Later, 1930 models were used, and while the concrete produced by them was no better than with the older ones, a much higher rate was possible. The difference in the mixer cycles between the old paver and the new paver was found to be surprisingly large. Because of this shorter mixing cycle alone, it is possible to obtain an increase of 10 per cent or more in production by using the new pavers. This fact is brought out by the data given in the table.

Because of the shorter mixing cycle and the better mechanical condition of the new paver, its actual advantage in effecting increased production was even greater than indicated above. The actual average hourly rates of production on Wisconsin State-aid project 2926 from the old and the new pavers, for each batch size during the period of the studies, was: For 27 cu. ft.—old paver, 188.1 sq. yd. per hour; new paver, 217.4. For 30 cu. ft.—old, 218.5; new, 257.6. For 33 cu. ft.—old, 222.5; new, 260.0.

To compare strength of concrete, cylinders were tested by compression after 28 days and beams after 7 days and 28 days, five samples being taken from each batch. The average results for concrete mixed by old and by new mixers is shown in the table below.

As for time of mix, the conclusion was that as uniform a mix could be obtained with 34 cu. ft. as with

	Size of Batch			
	27 cu. ft.	30 cu. ft.	33 cu. ft	35 cu. ft.
New Mixers—				
Compressive strength of cylinders at 28 days	3,594	3,667	3,685	3,790
Modulus of rupture of beams at 28 days	852	880	872	866
Old Mixers—				
Compressive strength of cylinders at 28 days	3,431	3,516	3,596	3,540
Modulus of rupture of beams at 28 days	885	883	901	901

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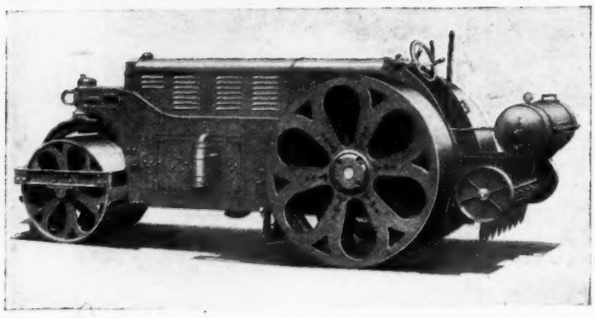

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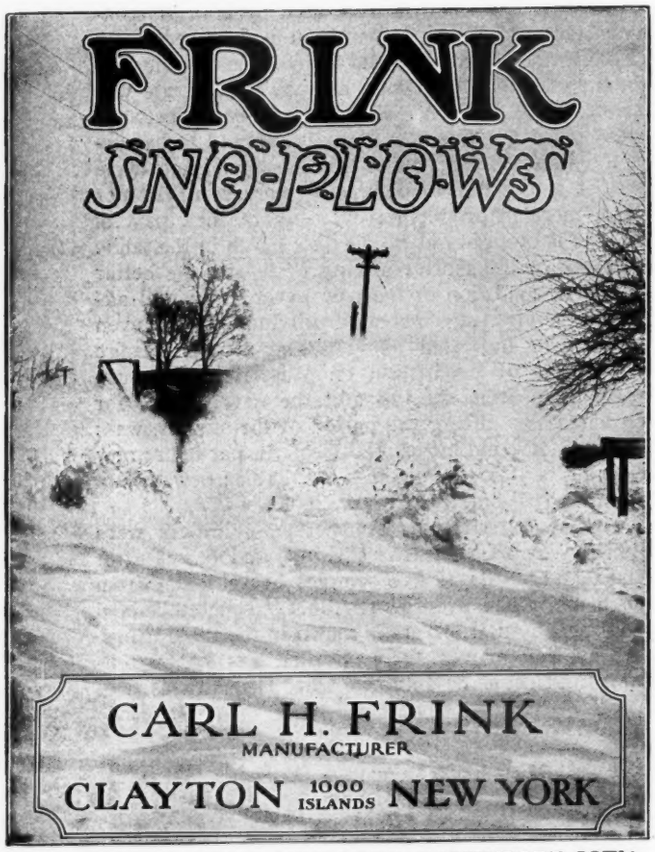

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any smaller size batch when all the solid materials are mixed for 55 seconds (batchmeter set at 60 seconds); and the same is true for 33 cu. ft. with the batchmeter set at 50 seconds, for standard 27E mixers with blades and buckets in fair condition.

On the basis of this investigation the State of Wisconsin is now permitting the use of a 33-cubic-foot batch and a 50-second mixing time for all the solid materials. The 33-cubic-foot batch allowance in Wisconsin is based on the fact that the spreader bucket of practically all 27E pavers now in use will hold this size batch in one discharge.

The manner and results of this investigation are reported in detail by T. C. Thee, assistant highway engineer, Bureau of Public Roads, in the January issue of "Public Roads," the official journal of the bureau.

Concrete Heaters Timed

A question often asked by a contractor is, "How fast can I turn out a batch of concrete with a heater unit on my mixer?" In general, a safe answer is, "About the same time as in summer weather—provided you also use a hot water heater." A concrete heater alone requires from 1½ to 3 times as long for the mix, in order to give the heater a chance to heat up the icy water and thaw out the frozen chunks of aggregate. If the piles of sand and gravel are heated in some way before being thrown into the mixer, it helps to cut down the extra time.

No two mixers are operated under exactly the same conditions. The size of the mixer, the time the batch is left in the drum, air temperature, water temperature, etc., always varies.

For this reason it is absolutely impossible to make an exact statement that a batch of concrete can be turned out so fast and so hot, but here is something you can use as a guide; it is based on a normal mixing time of 1½ minutes to the batch:

Concrete heater, with water heater, and aggregate thawed, 1½ min. Concrete heater and water heater, 1¾ min. Concrete heater only, 2 to 4 min.

This time schedule may be used under favorable conditions, but always remember that no hard and fast rules can be laid down.—*The Elbee Tatler.*

Surface Heater Repairing of Asphalt Pavements

In a report to the City Officials' Division, American Road Builders' Association, the committee on maintenance (Maj. F. M. Davison, chairman) stated that the "surface heater method of repairing asphalt pavements has now developed into what we feel to be the best method of accomplishing a major repair on asphaltic streets."

From reports from several cities, it seems that the average age of pavements so repaired is 15 to 18 years, the cost 40% that of entire replacement, and the added life 80% if the base be adequate.

One of the great advantages of this method is the short time the pavement is out of service. Repairs on a block of 2500 sq. yd. can be completed in less than three days, and local traffic to abutting property is never actually stopped for more than a small portion of a day. Each of several large eastern cities is using this method on more than 500,000 sq. yd. per annum.

The following are the committee's recommendations:

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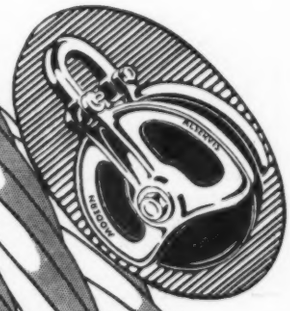

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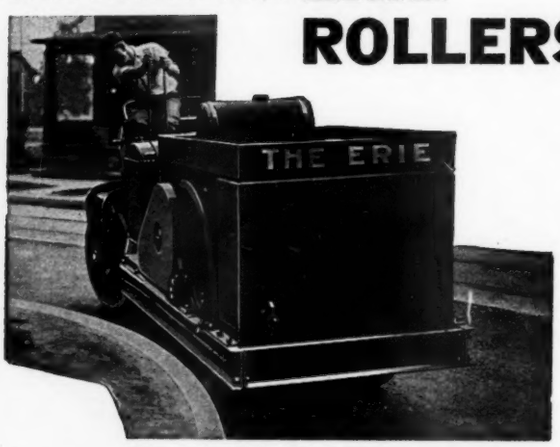

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1. If the base, though cracked, has apparently reached its final settlement and is adequate to handle the present and estimated increase in traffic for the next five years, it is safe to use the heater method.
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8. While equal areas of resurfacing have been done by city forces and by contract, very careful and skilled inspection is required under the contract method to insure complete removal of the old surface material and the laying of the new hot material on the base while still warm. The biggest danger in the contract method is that the contract may have to be awarded to the lowest bidder who has never done any such work previously and who may be inclined to use too little thought as to the quality and performance of his work, inasmuch as on this type of resurfacing it is not considered practicable to ask for a guaranty bond of maintenance. We do not wish, however, to give the impression that this type of work is limited in any of its respects to either city force work or contract—both have been very successfully accomplished.

Use of Quick-Setting Cement for Pavements

Apparently more than half the cities of the United States used more or less quick-setting (or high early strength) cement last year; and most of them found it satisfactory, though expensive. Of 501 cities answering an inquiry on this point in our questionnaire, about 300 or 60 percent reported using it. Of these, 291 used it for repairs but only 150 of these had used it for construction also; while 5 had used it for construction but not for repairs. Two-thirds or more of the cities reporting from each district except the East North Central, West North Central, West South Central and Mountain, had used such material. Of the users, 16 percent reported the results as "excellent," "very satisfactory," etc.; 6 percent found the results "unsatisfactory," "not successful," etc.; 62 percent reported results as "satisfactory," "good," "fair," and similar expressions. Presumably the remaining 16 percent took a successful performance as granted and so did not report it.

Several interesting comments were made. One Illinois city found it "O.K. for base but not always for wearing surface." A South Carolina city laid some which "raveled and crumbled." One Texas engineer announced himself as an "enthusiastic booster." One Kansas engineer said it was all right if temperature was above 70°, and another that it was "good in summer but not in winter," while an Illinois engineer had found it "very fine in the coldest weather," as had also one in Indiana. Quite a number considered a mix using one and a half or two times the ordinary amount of ordinary portland cement to be just as satisfactory at less cost. Others recommended, instead, the mixing of calcium chloride with the cement (2% said two, ½ lb. to a sack of cement said another).

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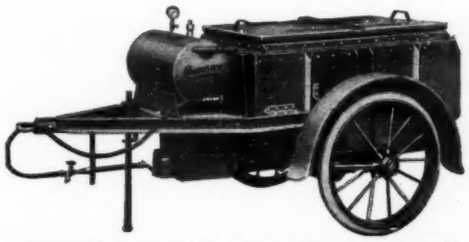

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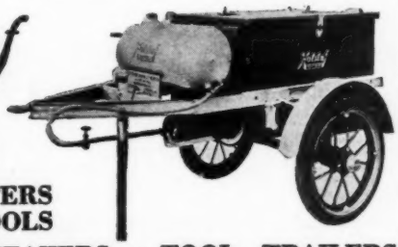

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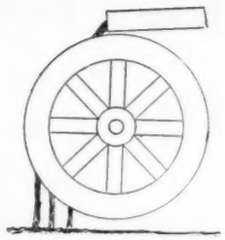
THE WATER WHEEL



By
Jack J. Hinman, Jr.

The essential features of important articles of the month having to do with water works design, construction and operation and water purification, arranged in easy reference form and condensed and interpreted by a leader in the water works field. Published every month to include articles appearing during the preceding month.

AT the beginning of 1932 we were reminded of the size and the degree of advancement which the **water works industry** has attained. In the United States alone the property valuation reaches the sum of five billion dollars[n112]. The great cities and the small towns are provided for. Of the latter, about 7300 places of population under 2000 have their own water plants[n112]. There has been material advancement in water purification[181]. In New York State alone seven new filtration plants have been put into service in 1931[n76] and that is not bad for a year of serious business depression. Considerable construction has been attempted in Great Britain and more is in immediate prospect[29, 31,140]. When fifty[172] or 100 years[28] is considered in water works progress, the advance appears phenomenal. Wonderful strides have been made in water purification in the last half century.

Water Sources

An extremely important decision was handed down by the Supreme Court of Arizona which does much to clarify the **underground water** situation in that state[48,n46]. This decision considers underground waters as percolating waters and therefore not subject to prior appropriation unless it can be shown clearly that they are flowing in definite channels. The case in question was decided against the owners of irrigation wells which were located below the site selected for a storage reservoir to be used in providing water for municipal supply.

In view of **failures of dams** which have taken place in the past, Hinderlider[119] and Markwart[118] insist that public supervision of such structures is a necessity. The analysis of causes of partial or complete failure of 293 dams is given in the first paper. The **stresses** in buttresses and dams are considered by Holmes[120] in a mathematical analysis. **Models and model tests** were of value in predicting the erosion below the Conowingo dam on the Susquehanna river operated by the Philadelphia Electric Company[49]. At Hamilton, Ohio, a depressed apron checked **erosion** below a dam[50]. Westergaard's paper on the effect of **earthquakes** on dams has attracted British attention[134]. Davis recommends the use of the **buttress type** of dam rather than the solid gravity type[64] and Howell shows a thrust buttress type for a high dam in a narrow rock canyon in Mexico[65].

Operation

At Aberdeen, South Dakota, advantage was taken of the presence of an old 30 inch **culvert** when a 12 inch pipe was to be laid under an embankment and the pipe was pulled through successfully[66]. The carrying capacity of La Ola pipe line in Chile falls off to an extent requiring the passage of a **"go-devil"** for cleaning purposes every six months. The new plant of the Western Electric Company at **Point Breeze,** Maryland, uses water from three different sources. These are the Patapsco river, the city supply available locally, and wells. The latter are used where cool water is required[47]. It is evident that care will be necessary to avoid confusion of piping. In connection with the **design of small water plants** Adams[138] points out that there are often proportionately greater variations in the pumping rates than in larger installations, and that for that reason too great reliance on general formulas is likely to lead to provision of insufficient quantities. The Alabama Water Service Company is systematizing and centralizing the **records of the distribution systems** of its thirty-six plants[157].

The Macopin Intake Reservoir of Newark, New Jersey, which holds 32,000,000 gallons was successfully cleaned with a "vest pocket" **suction dredge**[7]. The **mud removal** from the basins at the Chain of Rocks plant of the St. Louis Water Department is a difficult task requiring tractors to help move the heavier part of the deposit. During the period covered by the last annual report 435,302 cubic yards of sediments were removed at a cost of $0.0132 per cubic yard[n189]. Ehrhart[162] reports the **dismantling of an abandoned standpipe** by local unskilled labor at low cost. A derrick carried on a raft inside the standpipe was used. Rivets were cut off and punched out. Plates were lowered by the derrick.

Hall and Smith[94] in discussing the **selection of centrifugal pumps** stress the desirability of checking the pumps when new to see that they actually perform as desired and also the checking at intervals to see that the delivery does not fall off too much at given power cost.

Purification

The **floc detector** has been used with advantage at Hannibal, Mo., to determine lengths of filter runs[165]. Baylis[187] continues his discussion of the use of charcoal and **activated carbons** in water plants. At Saginaw, Michigan, the activated carbon has been applied to the clarified water on its passage through the plant. The stream water is subject to variable contamination with phenolic substances making necessary a rather high dosage of the carbon. According to Eckert[10] the amount used varies from 14 to 28 pounds per million gallons. Saint Johnsville, New York[n77], is using the **ammonia-chlorine** treatment to reduce taste troubles and also to secure residual chlorine remaining in the water for longer periods.

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Engineers from Great Britain, Germany, France and America answered.

"How long will it take?" asked the Companie.

"About three years," replied the French.

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Layne Hydrological experts spoke.

"Not more than 90 days! Perhaps not that long."

As far as their rivals were concerned, the Layne men might as well have said they intended to work a miracle.

"Three months? Why, that is impossible."

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PITTSBURGH DES MOINES

One of the Larger Incinerators

erected by "Pittsburgh-Des Moines" five miles from the limits of the *municipal water line for the city of Asbury Park, N. J. This sturdy well-built incinerator has a capacity of 180 tons every 24 hours. It is equipped with pneumatic charging hoppers. Note the neat landscaping and clean surroundings of this modern disposal plant.

The present-day clean American city demands the health and sanitation insurance which a "Pittsburgh-Des Moines" incinerator makes possible. Clean lawns, walks, streets and homes mean a healthy town in which people like to live.

Write for Incinerator Catalog

There are 24 pages of interesting cost data and illustrations of typical "Pittsburgh-Des Moines" plants for various cities in our new catalog. We have a copy here for interested municipal officials.

*It was necessary to supply an independent water supply for the above plant. The "Pittsburgh-Des Moines" organization, thru its waterworks construction department, drilled a deep well and installed the pump and water line to supply this big plant on the outskirts of one of America's famous coast resorts.

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ATLANTA—CHICAGO—DALLAS—SAN FRANCISCO—SEATTLE

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At the Powerton Station of the Superpower Company of Illinois, at Pekin, Stoll[115] has found that **chlorination** of the Illinois river water, using calcium hypochlorite locally prepared with chlorine and limestone, has allowed an average gain of 0.24 inches of mercury in vacuum. It is said that a gain of 0.06 inches would pay. Difficulty is due to the growth of the sewage fungus **sphaerotilus.**

Bunau-Valrilla describes the process of chlorination which he devolped under the name of **"verdunisation."** He believes that the emission of ultra violet light rays is responsible for the action observed. A process of sterilization of water is being advocated in France under the name of **"carbochlor"** process. It consists of chlorination of water with sodium hypochlorite and subsequent passage through activated carbon. Ickes[25] describes a small device called the **"filclorator"** which is intended to prevent clogging of orifices of chlorinators by mechanically removing impurities from the chlorine as it leaves the cylinder.

The process of water sterilization by **catadyn silver** has been further reported upon by Suckling[151] who finds it slower and more expensive than chlorine treatment and subject to interference by certain substances commonly present in natural waters, such as turbidity, color, iron, manganese, high chlorides, and hydrogen sulfide.

New **water softening plants** employing lime have been built for Quincy[170], and for Western Springs, Illinois[9]. Lancaster, Ohio, is to install a water softening plant of the **zeolite** type[n185]. Apparatus and methods for the laboratory study of **corrosion** are discussed by Prot and Goldowski in French[69]. Corrosion of metals in the brine tanks of **ice plants** are associated with the high alkalinity (pH 12.5) shown by the calcium chloride brines sometimes used. Apparently acids and sodium bichromate are very successfully employed in combatting such corrosion[117]. At the Maryland House of Correction corrosion of **hot water piping** was stopped by proper venting of a feed water heater to lower the dissolved oxygen content of the water[40].

Aeration of water in theory and practice are considered by Langelier who points out that temperature and initial concentration of oxygen and carbon dioxide are very important in the final result, but are beyond the control of the operator in most cases. Contact surface and time of contact however are determined by the design of the apparatus. Most of the available information concerning aerators has to do with nozzles and splash plate aerators. Very little information is available on the type of aerator where the air is forced through the water[95].

Management

The efforts of the American Water Works Association to secure Federal aid for the conduct of a **$550,000,000 improvement program** for the water works of the country seems to meet with general approval in the industry[n39,41,175,6]. It is proposed as a rational way to help solve the unemployment problem and at the same time take advantage of the favorable commodity prices for required materials.

In New Jersey a bill has been prepared to secure **permanency in office** of water and sewage treatment plant operators. Any superintendent or operator holding a state license under the law of 1918 who has held his position for five years is to be removable only for cause. Trials are to be conducted before the State Board of Health. In this way it is hoped to

(Continued on page 50)

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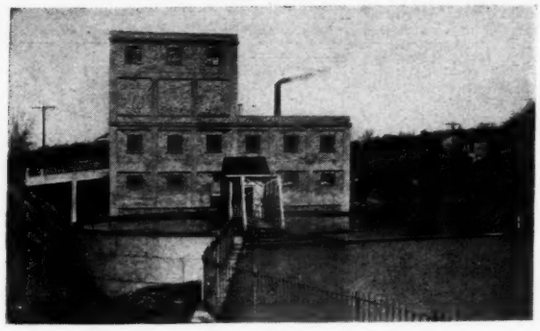

Treating Wool Scouring and Other Waste Liquors

THE treatment of trade waste liquors was the subject of a paper by Michael J. Blew, Major San. Res., before the American Society of Municipal Engineers.

After outlining concisely the sources of such wastes, their characteristics, infinite variety, etc., he considered the methods of treating them. For this purpose he divided them into four groups:

1. Suspended matter possessing a specific gravity greater than the supporting liquid.
2. Suspended matter possessing a specific gravity about the same as the supporting liquid.
3. Suspended matter possessing a specific gravity distinctly less than the supporting liquid.
4. Dissolved solids.

The suspended matters in group 1 settle readily and those in group 3 float, and both can be removed by ordinary mechanical means from tanks of suitable size. Solids in group 2 are often colloidal or semi-colloidal and removable only by filtration, coagulation, or chemical alteration of structure. Removal of group 4 solids can be accomplished only by chemical precipitation, or by oxidation in the case of organic matters.

Removal of suspended matters in groups 1 and 3, and in group 2 after coagulation, is usually aided by gravity, but centrifugal force may be employed to the same end. Various types of machines utilizing centrifugal force have been tried with varying degrees of success on different kinds of waste waters. One of the principal difficulties with such equipment has been the impossibility of producing continuous operation with automatic sludge cake removal. It is believed that recent researches will solve this problem, and that equipment will soon be available capable of continuous operation with a high degree of removal of solid matter.

The development of this equipment will materially assist in perfecting a series of closed systems in which the greater portion of process water can be recirculated and reused, thereby greatly promoting the restoration of polluted rivers.

There are many processes using enormous amounts of water that could treat their effluent, recirculate it and use it several times over to the advantage of the mill operator; in many cases the recirculation of process water being accompanied by a decrease in operating costs as well as a decrease in stream pollution. Circulation of effluent would result in a reduced cost of pumping, softening and heating water, which would help materially in defraying the cost of treatment.

The wool scouring industry is a notable example of such an industry. Wool coming from the back of a sheep always contains considerable foreign matter such as sand, dirt, cockle burs, manure, blood, grease, sweat, urine and body secretions. At times 50% of the original material is removed by washing.

Wool scouring waste therefore becomes one of the most putrescible and most polluting of all wastes. So damaging is such a discharge that often the waste from a wool scouring plant will do more harm to a river than the entire sewage from a city of thousands of people.

The feasibility of reusing wool scouring waste water was demonstrated ten years ago or more. The liquid was used over and over for several days instead of for several hours as had been the custom. The difficulty at that time was in effectively handling the enormous quantities of sludge produced. Plants have recently been constructed along these lines in England, France, Poland, Italy and America. The principal feature of the process is a centrifugal system for the continuous purification of wool scouring liquor from the first bowl of the ordinary wool scouring train. The entire process is closed, but about 10%-20% make-up water must be provided constantly to care for evaporation and to prevent the over concentration of soluble matter. In this case there is a considerable saving in soda and soap in addition to the saving in heat, water softening, and pumping.

The finished product resulting from wool scoured in recirculated water is said to be softer and easier to handle than wool scoured in the usual manner, due probably to the presence of soluble extractives from the scoured wool.

There are many other industries that are capable of the same sort of treatment as the wool scouring: for example, the paper industry, boxboard, coal washing, beet washing, cement, tanning, glue factory and possibly cannery. It is believed that this will prove to be a valuable line for further investigation.

★ *"When the Two-Main System is used, the only places where mains are under pavements are at intersections."*

A BROCHURE, sent upon request, discusses the Two-Main System as a factor in public relations as follows: "An important advantage that cannot be reduced to dollars and cents is the effect on public relations. Torn-up streets are a nuisance and anything that can be done to reduce the number of street openings is desirable. When the Two-Main System is used, the only places where mains are under pavements is at intersections. As no service connections are made at intersections, the necessity for street openings is practically eliminated since most street openings are made in connection with the installation or repair of services. Even where services are laid prior to paving in order to avoid street openings, the condition of pavements is very often interfered with, due to the laying of pavements over ditches that have not had time to settle. By keeping mains and services from beneath pavements, this irregularity in street surface is avoided."

★ Excerpt from "The Two-Main System of Water and Gas Distribution", a brochure issued by THE CAST IRON PIPE RESEARCH ASSOCIATION and sent upon request to interested engineers. Address THE CAST IRON PIPE RESEARCH ASSOCIATION, THOMAS F. WOLFE, Research Engineer, 309 Peoples Gas Bldg., Chicago.

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Sewage Disposal Plant

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THIS Sewage Treatment Works is one of the separate sludge digestion type, followed by sand filtration.

The settling tanks are below grade as the sewage flows through them by gravity. The sludge beds are constructed over the settling tanks, thereby eliminating waste "freeboard." The digestion tank extends above the level of the settling tanks and forms the interior wall supports for the glass superstructures constructed over the sludge beds.

The grit and screen chamber is also equipped with a glass superstructure.

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provide these essential
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Mosquitoes Breed in Sewage Plants and Effluents

THE total expenditure for sewage treatment plants in New Jersey represents an investment of well over 90 millions of dollars.

In 1930 about 90 per cent of the population of the state was provided with sewerage systems. About 35 per cent of the population having sewers, or about 1,270,000 people, discharged its sewage untreated into rivers and water courses. Roughly, 200 million gallons of sewage daily is partially or completely treated in about 350 treatment plants, to which volume a portion of the 200 m. g. d. of trade wastes must be added.

The main purpose of these plants is to prevent the creating of a nuisance in the streams which receive the sewage. Comparatively little attention has been given to the possibility that they may be the cause of another form of nuisance—breeding of mosquitoes. Some suggestions on this point were made by Dr. Willem Rudolfs in an address before the New Jersey Mosquito Extermination Association in February, from which we quote the following paragraphs, as well as the figures given above.

"During the past summer alone I have observed breeding of mosquitoes in five different disposal plants, three of which bred mosquitoes very profusely. There is no question that even in this stagnant, actively decomposing material mosquitoes will thrive. Vastly greater numbers of mosquito larvae and pupae may be found, however, in effluents from plants which are discharged into ditches or pools, or placed on sand beds for further treatment. Partially treated sewage (subjected to sedimentation, etc.) contains quantities of materials in solution which may be in itself a good food supply for the larvae; also the soluble and finely divided materials are excellent food for the small plants and animals (protozoa, fungi, algae) which may make up a considerable portion of the food of the larvae.

"A poorly designed sewage treatment plant or a plant of insufficient capacity to detain the sewage long enough to allow the suspended solids to settle may be a source of intensive mosquito breeding. The solids which should be retained pass out of the tanks into the ditch or channel. If the ditch meanders or the slope of the ground is such that the effluent moves very slowly or stagnant pools are created, prolific breeding is bound to occur. Poor operation of a well designed plant may create similar conditions. In some instances the tanks are full with sludge and the effluent is run onto sand beds. Soon these beds clog and the water stands on top for a considerable length of time, making breeding conditions ideal.

"The first measure for abatement that appeals to the mosquito exterminator is to straighten and clean the ditch which receives the effluent from the sewage plant. The ditch may be full of actively decomposing sludge, so that the most efficient part of the treatment plant is the ditch which is supposed to receive the clarified effluent. It is clear, however, that with continuous discharge of sludge into the ditch, cleaning and straightening out will help only temporarily, if at all.

"It is sometimes possible to alleviate nuisances by chlorination of the effluent. The chlorine, in addition to safeguarding health and reducing odor troubles, destroys a certain portion of the materials in solution and suspension. It acts as a deterrent and delays the

further decomposition of the materials in the effluent. This delay may be sufficiently long to permit the effluent to reach a larger body of water where it is diluted or where the flow is sufficiently swift to prevent breeding. The chlorine kills not only the bacteria, but also small aquatic life which is a good source of food supply for mosquito larvae, so that breeding may be greatly reduced or even eliminated."

Porous Plates for the Largest Activated Sludge Plant

The largest activated sludge plant yet placed under construction is now being built on Wards Island, New York City, and most of the equipment has already been provided for. It is reported that one of the latest contracts is for the porous plates to be used in introducing the air into the tanks, an order for 40,000 plates, each a foot square, having been let to the Norton Company.

Chlorination of Water Supplies in New York

There were, on January 1, 169 municipalities in New York State which used chlorination alone as a method of treating their water supplies and 103 others which used it to supplement treatment by filtration. Ten or more installed chlorinators for the first time in 1931.

Color of Water Reduced by Draining Swamps

New Bedford, Mass., obtains its water supply from Quittacas ponds, from which it is pumped 8¼ miles with a 164-foot lift to a distributing reservoir. There is considerable swampy land adjoining the ponds, which gave a rather high color to the water draining from them into the ponds, and also furnished food for algae which at times gave trouble by their abundance.

To eliminate or diminish these objectionable features, the water department has, since 1925, been carrying out a program of draining the swampy area, so far confining the work largely to that around Little Quittacas pond. The effect is already notable in the color of the water delivered to the distributing reservoir. More than 500 color determinations have been made at regular intervals during the past 32 years by the State Department of Public Health, from samples collected in Little Quittacas, and the average of these is 0.29 on a color scale of which 1.00 is a yellowish brown. The average of 60 such determinations made during 1930 and 1931 is 0.16; showing a reduction of nearly 50 percent in color.

Ditching is to be continued around Great Quittacas, and the color will undoubtedly be lowered still further.

Cast-Iron Sewers

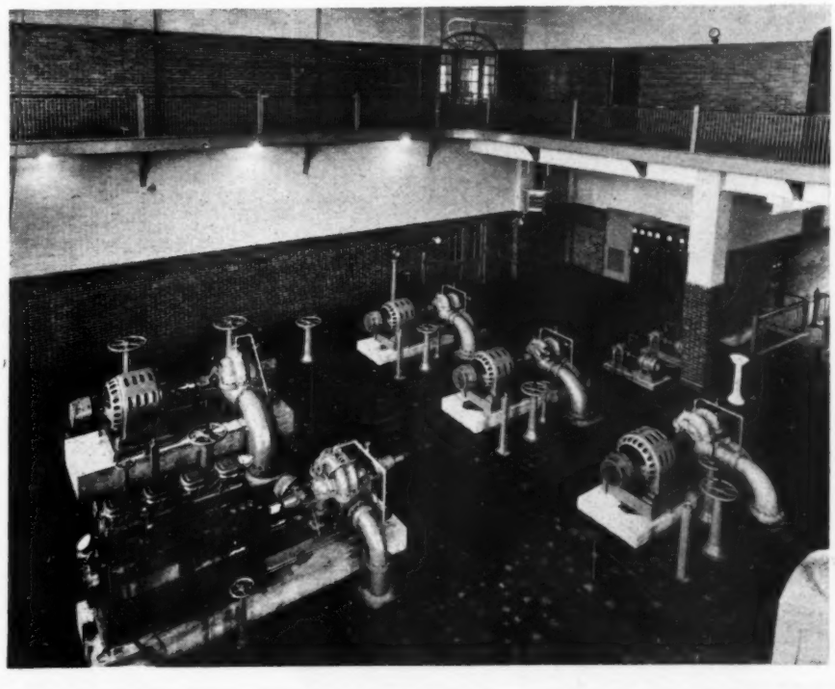
In speaking before the Maryland-Delaware Water and Sewerage Association concerning materials used for sewers, Robert B. Morse, chief engineer of the Washington Suburban Sanitary District, said:

"I am using cast-iron pipe for trunk sewers 30 inches and larger in diameter. Have found on about three-fourths of a mile of 30-inch line the total cost was about $1.25 a foot less for the cast-iron pipe than with reinforced concrete pipe. With reinforced concrete pipe the material, of course, costs considerably less, but the speed of the job with the reinforced concrete pipe is determined by the speed with which you can lay the pipe. The speed of the cast-iron job is regulated by the speed of the trenching machine. Putting the pipe in in 12-foot lengths, the jointing is much simpler. The 30-inch line of cast-iron is about as good in carrying capacity as a 33 or 34-inch pipe of reinforced concrete. It cost us about the same to lay a 36-inch cast-iron line and a 36-inch reinforced concrete line, about a mile in length. We used the same old trenching machine. Since then, we have gotten a new machine and we find that the cast-iron pipe is cheaper."

Highland Park, Ill., Electric Pumping Plant

A recently installed pumping plant at Highland Park, Ill., consists of four motor-driven centrifugal pumps and a stand-by unit operated by a gasoline engine.

The four synchronous motors which drive the high-head centrifugal pumps are 300 h.p. at 1200 r.p.m., and 150 h.p. and 100 h.p. at 1800 r.p.m., operating at unity power factor and 4000 volts. The pumps were furnished by De Laval and the motors by the Electric Machinery Mfg. Co. A Sterling engine is used in the stand-by unit.



Pouring two pipe sections on job in Boro of Richmond, New York City. When using Ex-XL-cell two or more sections may be poured outside the trench, thus saving labor in restricted trench space.

EX-XL-CELL SAVES MONEY, TIME AND LABOR

Ex-XL-cell melts freely, cools rapidly, and sets in a few minutes after the joint is sealed. Two or three joints may be poured outside and lowered into the trench as a unit thereby reducing labor in the restricted space of the trench.

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Ex-XL-cell being used in Union County, New Jersey. Notice the fill at top of picture. When Ex-XL-cell is used, trenches may be back filled as fast as pipe laying progresses as compound sets immediately.

When writing, please mention PUBLIC WORKS

The Water Wheel

(Continued from page 44)

avoid political removal of capable and experienced men[n52,n174,176].

The manner of payment for the **water used by gas-operated refrigerators** has come in for discussion recently[173,192]. The low flows of water required do not secure full registry on some meters and thus the water may be secured without sufficient charges being made. Flat rates for the refrigerators have been advocated. Apparently 60 to 75 gallons of water per day are used.

Since early December rains in the southeastern states have relieved the water shortage being felt there[n45]. The drought of last year has made **rainfall records** over long periods even more desirable in predicting the amount of water required for a safe margin of quantity. **Cycles of weather** as indicated by tree rings, varves, sun spots and such old records as that of the Nile inundations are being carefully studied in the effort to learn about droughts[27,44,182]. From the Nile record it seems that in the last 848 years there have been single droughts lasting as long as 13, 11 and 10 years, two droughts each of 7 and 8 years, five droughts of 6 years, nine droughts of five years, and so on[44].

The American Institute of Chemical Engineers devoted much of the time of their 24th annual meeting to the discussion of **stream pollution.** Efforts at the improvements of streams are widespread and urgently needed. The state of New York is setting a good example to the communities by providing for better sewage treatment at the **state institutions.** New York has also entered into a compact with New Jersey and Connecticut for the **protection of shore waters** from pollution.

The Annual Report of the Water Pollution Research Board of Great Britain[197,136,139,] contains some very interesting material of value to water works men. Of these, the treatment of wastes to prevent **phenol** concentrations in stream waters and the studies on zeolites are outstanding. The fact that zeolites are capable of **removing traces of lead, copper,** zinc and other metals may be important where such metals are likely to be met with. The interesting caution is given in regard to lead that sodium chloride, commonly used in the regeneration of zeolites, would lead to the formation of insoluble lead chloride. For this reason sodium nitrate (sometimes called Chile saltpeter) is recommended.

Laboratory and Public Health

Hammond and Goffey[146] find that the **iron bacteria** generally have a preference for the lower pH ranges in water supplies and that raising the pH of a water to 8.4 or 8.6 is necessary to stop the action of these organisms. The organisms will grow well in some instances in water as alkaline as pH7.8. A minute pin hole in the pipe coating, leaving bare iron exposed is necessary for tubercle formation.

Tonney and Noble[106] studying the **persistence of the Bacterium coli and the Bacterium aerogenes** in nature find the latter able to live for a long time in wood. Where wooden casings are used in wells, the presence of Bacterium aerogenes has little sanitary significance, in their judgment. In sewage they find that the ratio of Bacterium coli to Bacterium aerogenes is approximately 100 to 1, but in soils the ratio is 1:20. Allan Gray[110] agrees in general with the opinions of Tonney and Noble, and finds a tendency for the Bacterium coli to **die out on storage** while the Bacterium aero-

genes may persist or multiply. Tonney and Noble found on decaying wood that Bacterium coli and Bacterium aerogenes died off at about the same rate under winter conditions.

In discussing the **vegetable growths** in water supplies, A. E. Berry[100] mentions the case of a lake in Hastings County, Ontario, where there was an exceedingly abundant growth of the blue green alga, anabaena. In one bay of the lake the algae died. Twenty head of cattle and sheep that drank of the water of this bay died. Similar circumstances have been reported before and are found as apparently authenticated in books on algae. However there still remains some doubt as to the nature of the toxic substance. On one occasion where this action was reported, a heifer and colt fed with the algae from the same point, and with larger quantities of the material, were unharmed. Additional information on this matter should be secured because heavy growths of blue green algae sometimes occur in waters afterward used for public water supplies. No known instance of anything more serious than disgusting taste has come to the attention of the writer. Veldee's paper in the November, 1931, number of the American Journal of Public Health, mentioned in the Water Wheel for December, 1931, should be remembered in this connection. It concerned an epidemic of gastro-enteritis of undetermined origin which began upstream and worked down through the cities using water from the Ohio river after subjecting it to more or less complete treatment.

Red worms found in the water supply of Cincinnati proved to be chironomous larvae—the larvae of a midge. Although the insect's presence does not indicate pollution by sewage matters, the presence of the bright red larvae is noted quickly and with alarm by the consumers. The eggs of the larvae are laid on a water surface.

Manganese in a water supply reservoir near Asheville, North Carolina, was apparently due to reduction associated with the decay of organic matter. Local soils contained manganese. The fall turnover of the water in the lake brought up the manganese. It was combatted successfully by the use of alum, soda ash, potassium permanganate, chlorine and sodium aluminate. Bleeding the bottom water from reservoir was also helpful. The manganese content reached a maximum of 1.0 part per million in the raw water but was kept below 0.02 ppm. in the treated water when the treatment was adjusted to the conditions. A survey of water supplies in Texas by Jessen[97] showed most of the waters to be free from manganese. Among those tested, the maximum content was 3.6 parts per million of manganese.

Two unusual **gastro-intestinal disturbances** in naval personnel were reported by medical officers. One of these on the U.S.S. Vestal was apparently of **chemical nature** associated with the taking of water from the reserve feed bottom of the ship[143]. The other was associated with the use of **ice** believed to have become contaminated in manufacture[144]. Both of the epidemics were mild.

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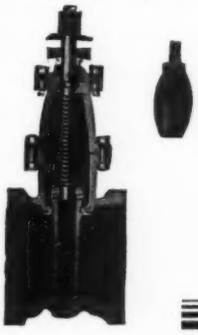

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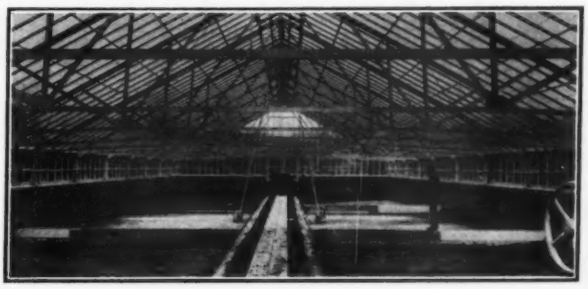

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Pav., curb., gutter., drain. sys., etc., rdwy. Ericsson Memorial just so. of Br. Plaza.—Arlington Memorial Br. Comn., Office Executive Officer.

Ill., Springfield— 10 a. m., Mar. 9
Grad., rt. 80, sec. 103A, involv. 36,200 cu. yds. excav., Jo Daviess Co.—Dept. Publ. Wks. & Bldgs., Div. Hwys.

Ill., Springfield— 10 a. m., Mar. 9
For bit. filled brk. pav. on port. cem. conc. base course, 86.80 mi. in 18 cos. Dept. of Public Works and Bldgs., Div. of Hwys., Frank T. Sheets, Ch. Hwy. Engr., Springfield.

Ind., Brazil— 10 a. m., Mar. 19
Grad., drain. and pav. William B. Williams, et als rd.—Lewis H. Schopmeyer, Aud., Clay Co. Court House.

Ind., Indianapolis— 10 a. m., Mar. 9
For improv. Michigan St.—Dept. of Public Works, Indianapolis.

Ind., La Porte— 1:30 p. m., Mar. 12
Constr. of Lewis Harness et al rd.; est. cost $58,372.—Roy W. Leets, Aud., La Porte Co. Court House.

Kans., Dodge City— 9 a. m., Mar. 9
Earthwk. and culvts. and Port. Cem. conc. pav. 5,445 mi. Ford Co.—Clk, Court House.

Ky., Frankfort— 2 p. m., Mar. 23
Constr. 51.4 mi., Carroll-Henry, Kenton, Nicholas, Owen, and Robertson Cos.—The State Hwy. Comn. of Ky., Div. of Constr., Frankfort.

Md., Baltimore— Mar. 8
Conc. pav. 4.65 mi. Cont. AA-118-72, Anne Arundel Co., gravel. 1.0 mi. Cont. C-58-82, Calvert Co.; gravel. 1.01 mi. Cent. Ch-88-82, Charles Co.—State Roads Comn., Federal Reserve Bank Bldg.

Md., Baltimore— Mar. 15
(1) Balto. City—conc. shoulders & comb. curb & gutter, 1.54 mi., Cont. Bc-113-74, Reisterstown Rd. (2) Garrett Co.—conc. pav., 1.70 mi., Cont. G-67.62 & 2.43 mi., Cont. G-73-64.—State Rds. Comn., G. Clinton Uhl, Chmn., Federal Reserve Bank Bldg.

Md., Baltimore— Mar. 15
Surf. treat., 19.31 mi., Dists. 1 & 2; 47.97 mi. Dists. 3, 5 & 8; 254.03 mi., Dists. 3A, 7 & 8A; 36.17 mi., Dist. 4; also 4.52 mi., Dist. 6; involv. 1,480,748 gal.; also furn. 500,000 gals. tar cold patch; 500,000 gals. asph. cold patch & 350,000 gals. penetration asph. (more or less).—State Rds. Comn., G. Clinton Uhl, Chmn., Federal Reserve Bank Bldg.

Mich., Plymouth— 10 a. m., Mar. 8
Improv. 2.462 mi. rd. in Farmington Twp., Oakland Co.—State Twy. Comn., H. G. Oakes, Div. Engr., Plymouth.

Mich., Plymouth— 10 a. m., Mar. 16
Grad., const. nec. drain. structs. 2.820 mi., Stephenson Hwy. Oakland Co.—H. G. Oakes, Div. Engr., Plymouth.

Minn., Two Harbors— 10 a. m., Mar. 10
Grad. & gr. surf., 6.6598 Ely-Finland Rd., Lake Co.—Paul W. Nelson, Aud., Court House.

Minn., West St. Paul— 8 p. m., Mar. 10
Sidewalks, curb & gutter, rd. surf. matl., var. sts. in city.—B. Wallner, City Clk., City Hall.

To be of value this matter must be printed in the number immediately following its receipt, which makes it impossible for us to verify it all. Our sources of information are believed to be reliable, but we cannot guarantee the correctness of all items. Parties in charge of proposed work are requested to send us information regarding it as soon as possible, also corrections of any errors discovered.

Mo., Jefferson City— 10 a. m., Mar. 11
Graded earth 25.109 mi. 8 cos.; gravel. 95.255 mi. in 29 cos.; conc. pav. 94.272 mi. in 27 cos., 12.976 mi. Port. cem. conc. pav. Miller Co., shale 4.024 mi. Putnam Co.—State Hwy. Comn., State Hwy. Bldg., Jefferson City.

O., Cincinnati— 12 M., Mar. 8
Constr. and repair cement sidewalks for period of 1 yr.—C. A. Dykstra, City Mgr.

O., Cleveland— 11 a. m., Mar. 11
Pav. and improv. Green Rd. No. 8.—Co. Comrs., F. J. Husak, Clk.

Ohio, Youngstown— 11 a. m., Mar. 10
Improv. Messerly Rd. No. 257, Canfield Twp., Mahoning Co.—Co. Comrs., F. E. Lancaster, Clk., Court House (Geo. M. Montgomery, Co. Engr.).

Okla., Oklahoma City— Mar. 8
Grad., drain., approx. 43.601 mi., Harmon, Cotton & Ellis Co's.—State Hwy. Comn., Sam R. Hawks, Chmn.

Sewage and Sanitation

Conn., Hartford— 10 a. m., Mar. 10
Const. sews., sludge beds, filters, and cement tanks, for sewerage sys.—Bd. of Trustees, Mystic Oral School for Deaf, State Water Comn. Office, Hartford.

D. C., Washington— Mar. 9
Sew. and storm drainage at Naval Air Sta. at Corry Field, Pensacola, Fla.—Office of Ch. Bureau of Yards and Docks, Navy Dept., Washington.

Mo., St. Louis— Mar. 15
Constr. Section B-4, Section B-7 and Sect. B-8, Western Mill Creek Public Relief Sews.—Bd. of Pub. Service.

N. Y., White Plains—11:30 a. m., Mar. 10
Constr. comfort sta. and gasoline sta. No. 4, includ. equipmt., etc. on Bronx Parkway Exten. and Crompond Rd., Westchester Co.—Westchester Co. Park Comn., 72 West Pondfield Rd., Bronxville, (Jay Downer, Chf. Engr.).

N. C., Roanoke Rapids—2 p. m., Mar. 14
Constr. & furn. matl. for san. sew. sys., san. sew. outfill line & sew. pump. sta.—San. Dist. Bd. of Roanoke Rapids San. Dist. (Spoon & Lewis, Engrs., Greensboro).

O., Baltimore— 12 M., Mar. 21
Sew. start. at intersect. of Walnut St. and Monroe St.—U. D. Lines, Clk., Vill. Hall.

O., Cincinnati— 12 M., Mar. 8
Constr. sew. in Boynton Pl., Heekin Ave.—C. A. Dykstra, City Mgr.

Tex., Dallas— Mar. 9
Constr. East Fork storm sew.—F. N. Baldwin, Asst. City Engr., City Hall.

Va., Richmond— 3 p. m., Mar. 15
Constr. Bacon Quarter Branch Relief sew., involv. 500 lin. ft. 8 ft. by 12 ft. box sew., etc.; also furn. & deliv. approx. 28,000 salt glazed vit. clay liner plates.—R. Keith Compton, Dir. Publ. Wks., 1111 E. Broad St.

W. Va., Parkersburg— 10 a. m., Mar. 9
For constr. 8 in. sani. sew. 25th St.—Myrtle L. Hoffman, Clk. (L. G. Merrill, City Engr.).

Wis., Cedar Grove— 1:30 p. m., Mar. 11
Constr. sew. sys.—L. J. Meylink, Clk., Village Hall.

Water Supply

N. Y., West Haverstraw—2 p. m., Mar. 29
Constr. water supply at New York State Reconstruction Home, Rockland Co., est. cost, $23,017.—Dept. of Health, State Office Bldg., Albany.

N. C., Roanoke Rapids— 2 p. m., Mar. 14
For water distribution sys.; also elevated tank, 500,000 gal. capy.—San. Dist. Bd. Roanoke Rapids San. Dist. (Spoon & Lewis, Engrs., Greensboro).

Ohio, Cincinnati— 12 M., Mar. 14
Repair. wk. on water mains, st. valves, fire hydrants & install. new st. valves & fire hydrants.—Bd. Publ. Affairs, E. J. Spraul, Clk., 612 Arlington Ave.

O., Cincinnati— 12 M., Mar. 15
Constr., erect. one steam turbine Driven Centrifugal pump and appurtenances at Main Pump. Sta. capy. 25,000,000 gals.; est. cost $150,000.; two steam turbine driven centrifugal pumps. at Western Hills Sta.; capy. 5,000,000 and 10,000,000 gals.; est. cost $75,000.—C. A. Dykstra, City Mgr. (C. H. Anderson, Chief Mech. Engr., 2545 Eastern).

O., Zanesville— 12 M., Mar. 8
Erect. elevated steel water rank N. E. Cor. Cliffwood Ave. & Shelby St.—Jas. McKinney, Ser. Dir. (Barstow & McCurdy, Inc., Consult. Engrs., 31 No. Summit St. Akron).

Pa., Meadville— 5 p. m., Mar. 15
Constr. 2,200 lin. ft. 4x5½ ft. conc. box storm conduits.; est. cost $25,000.—G. Stabley Maxwell, Clk., City Hall.

Wis., Cedar Grove— 1:30 p. m., Mar. 11
Constr. waterworks sys.—L. J. Meylink, Clk., Village Hall (A. E. McMahon Engrg. Co., Engrs., Menasha, Wis.).

Wis., Waukesha— 2 p. m., Mar. 10
Deepen., clean., case & test well (former bids rejected).—Bd. Water Comrs., 132 North St., Jay. G. Laing, Pres.

Bridges

Ill., Springfield— 10 a. m., Mar. 9
Constr., var. types of brs. in 10 Counties. —Div. of Hwys., Frank T. Sheets, Chf. Hwy. Engr., Springfield.

Ind., Indianapolis— 10 a. m., Mar. 15
For constr. bridges in Bartholomew, Clay, Fulton, Lawrence, Martin, Parke, Porter, Pulaski, Putnam, and Wayne Cos.—J. J. Brown, Dir. Indiana State Hwy. Comn., State House Annex, Indianapolis.

Kans., Wellington— 9 a. m., Mar. 22
Earth and culvts., and 10 mult. box spans, Sumner Co.—County Aud., Fifth Div., Court House.

Kans., Dodge City— 9 a. m., Mar. 9
Constr. culvts. and bridges in Hogdeman, Ness Cos.—Clk. Court House.

Md., Baltimore— 12 M., Mar. 8
Constr. Br. Charles Co., and struct. steel superstruct., Frederick Co.—State Road Comn., G. Clinton Uhl, Chmn., Federal Reserve Bank Bldg., Baltimore.

Md., Baltimore— Mar. 9
For constr. steel br. on Hanover St.—Dept. of Public Works, Bureau of Harbors, Fred. W. Kipp, foot of Broadway (J. E. Griener, Engr., 1201 St. Paul St.).

Minn., Grand Rapids— 10 a. m., Mar. 8
Constr. timber br. located in Sec. 36, over Lawrence River.—Thomas Erskine, Aud., Itasca Co. Court House.

Mo., Jefferson City— 10 a. m., Mar. 11
Constr. 35 bridges in 21 counties.—State Hwy. Comn., State Hwy. Bldg., Jefferson City.

N. J. Camden— 2:30 p. m., Mar. 16
Constr. of creosoted fender sys. at tower pier of Delaware River br. on Philadelphia side of Delaware River.—Delaware River Joint Comn., Jos. K. Costello, Genl. Mgr., Administration Bldg., Bridge Plaza, Camden.

O., Gallipolis— **12 M., Mar. 11**
Constr. br. over Raccoon Creek, at Cora.—Co. Comrs., F. A. Haskins, Co. Engr.

Okla., Oklahoma City— **Mar. 8**
Constr. 4 brs. in Cotton, Ellis & Harmon Co's.—State Hwy. Comn., Sam R. Hawks, Chmn.

Wis., De Pere— **11 a. m., Mar. 15**
Constr. steel and conc. bascule span over Fox River and Govt. canal and C. M. St. P. & P. Ry. tracks, on U. S. 41.; est. cost $500,000.—Wis. Hwy. Commn., Madison (D. F. Culbertson, State Div. Engr., Green Bay).

Wis., Milwaukee— **11 a. m., Mar. 8**
9 steel sluice gates, and 76,240 lbs. struct. steel.—U. S. Engr. Office, Federal Bldg., Milwaukee.

Wis., Superior— **10 a. m., Mar. 8**
Constr. Wood River Br., Burnett Co.; Crooked Rapids Br., Sawyer Co.—Wis. Hwy. Comn. and Co. Hwy. Committees of Burnett and Sawyer Cos., 1517 Tower Ave., Superior.

Drainage and Irrigation

Ill., Chicago— **11 a. m., Mar. 15**
Dredg. and excav. 1,954,000 cu. yds. earth and 223,000 cu. yd. rk. from Marsellles Pool, on Illinois River.—U. S. Engr. Office, First Chicago Dist., 333 N. Michigan Ave., Room 1325.

Miscellaneous

Mo., St. Louis— **11 a. m., Mar. 19**
65 sections 1170 ft. 24 in. diam. discharge pipe.—U. S. Engr. Office, 428 Customhouse, St. Louis, Mo.

Ill., East St. Louis— **Mar. 10**
Complet. West Levee Proj. 12, from Millstadt Rd. to pt. 7,000 ft. southwardly; est. cost $90,000.—Bd. Comrs., East Side Levee & Sani. Dist., J. D. Johns, Pres., 217 Metropolitan Bldg.

La., New Orleans— **12 M., Mar. 29**
Constr. two hangars, etc. at Shushan Airport on Lake Pontchartrain.—Bd. of Levee Comrs., Orleans Levee Dist., 606 Common St.

Mo., St. Louis— **11 a. m., Mar. 19**
Furn. and const. 20 steel pontoons, 47½ ft. x 16 ft. x 3 ft.—U. S. Engr. Office, 428 Customhouse, St. Louis.

N. Y., Binghamton— **2 p m., Mar. 17**
Driving test piles at Binghamton State Armory, Broome Co., est. cost, $2,275.00. —Executive Dept., Div. of Military & Naval Affairs, Capitol, Albany.

Pa., Philadelphia— **12 M., Mar. 17**
Constr. & furn. matl., for erect. 8 steel sextant towers, along New Jersey & Delaware shores of Delaware River & Bay, bet. Old Mans Pt., N. J. & Cohansey River, N. J.—Distr. Engr., U. S. Engr. Off., 1109 Gimbel Bldg., 35 So. 9th St.

Tenn., Memphis— **2 p. m., Mar. 10**
Constr. abt. 12,000 cu. yds. earthwk. in vic. of Jacksonport, Ark., Levee Distr. 2, Jackson Co.—Distr. Engr., U. S. Engr. Off., McCall Bldg.

Va., Langley Field— **Mar. 11**
Constr. seawall extn.—Constr. Quartermaster, Langley Field, Hampton, Va.

Contemplated Work
Streets and Roads

Ill., Wilmette—Contemp. pav & widen. Main St., from Elmwood Ave. to Kenilworth limits, est. $39,700.—C. M. Osborn, City Mgr., City Hall (Chas. N. Roberts, Engr., 105 N. Clark St., Chicago).

Ia., Anamosa—Contemp. grad., surf. 41 mi., est. cost, $80,000.—LaVern Rockstad, Aud., Jones Co.

Ia., Muscatine—Contemp. grad. & surf. this yr., approx. 10 mi., Muscatine Co.—Kenneth Coder, Aud., Court House (F. P. G. Halbfass, Co. Engr.).

Kan., Buhler—Contemp. surf.. some city sts.; blotter treatment under consideration—City Clk., City Hall.

Minn., Glencoe—Bids prob. taken in Apr. for grad. & gr. surf abt. 20 mi., est. $45,000.—J. J. Leasman, Aud., Court House (I. C. Christlieb, Co. Engr., Glencoe).

Minn., Grand Marais—Contemp. constr. hwy. from Grand Marais on E. to Grand Forks on W, wk. to be done this summer—Steel-to-Wheat Hwy. Assn., Inc.

Minn., Hibbing—Contemp. improv. pav., cost $94,000.—H. F. Dear, Clk., Vill. Hall.

Minn., Red Wing—Wk. to be done this summer, grad. & gr. surf., 17½ mi., est. $113,000, Goodhue Co.—C. T. Taylor, Aud., Court House (J. A. Prior, Co. Engr.).

Minn., Windom—Contemp. constr. C. A. R. No. 12, 7 mi.; C. A. R. No. 11, 5 miles, & C. A. R. No. 8, 3 mi., Cottonwood Co.—L. L. Klasse, Aud., Court House (C. W. Gove, Co. Hwy. Engr.).

Neb., Westpoint—Ordinance passed for gutter, drain, etc., certain sts. in Dist. 12. —C. E. Mead, Clk., City Hall.

Ohio, Cincinnati — Considering reinf. concr. pav. & concr. curbs & nec. drainage for Lower River Rd.—Co. Comrs., E. J. Dreihs, Clk. (E. A. Gast, Co. Engr.).

Ohio, Ironton — Contemp. constr. rd. above Coal Grove; also new br. over Lick Creek, est. $150,000.—State Hwy. Dept., O. W. Merrell, Dir., Columbus (B. E. McCown, Res. Engr.).

Ohio, Youngstown — Prob. start wk. soon, for constr. rdwy., extn. Lakeview Ave., etc.—F. E. Hughes, Pk. Supt., City Hall (wk. in Mahoning Co.).

Tex., Marlin—Falls Co. Rd. Dist. 9, voted $450,000 rd. bonds.

Wis., Hurley—Bids in Apr., grad., 20 mi., Birch-Ironwood Rd., Proj. 452-A, est. $190,000, Iron Co.—Angus J. Lamont, Co. Hwy. Comr. (S. A. Koszarek, State Div. Engr., Rhinelander).

Wis., Lancaster—Will let contrs. in March., grad. 4.6 mi., Lafayette Co. & 10 mi., Iowa Co.—State Hwy. Comn., M. W. Torkelson, Act. State Hwy. Engr., Madison.

Wis., La Crosse—Auth. surf. Hwy. 162, concr. or tar pene., $100,000; also Hwy. 33, concr., $90,000, & Hwy. 108, same, $60,000.—Esther Domke, Clk., La Crosse Co., Court House.

Wis., La Crosse—Contemp. pav. Gillette St.—F. L. Kramer, Clk., City Hall (J. T. Hurd, City Engr.).

Wis., Madison—Consider. relocat. S. T. Hwy. 11, bet. Mazomanie & Arena, Dane & Iowa Co's.—State Hwy. Comn., K. G. Kurtenacker, Sec.

Wis., Marinette—Resol. adopted for pav. Logan, Hall Aves., etc.—A. L. Hollis, City Engr., City Hall.

Wis., Merrell—Rdy. for bids in Apr., grad. 4 miles, Tomahawk-Cassian Rd., Proj. 431-C, est. $60,000, Lincoln Co.—H. H. Kuehling, Co. Hwy. Comr. (S. A Koszarek, State Div. Engr., Rhinelander).

Sewers and Sanitation

Ind., Kendallville—Rdy. for bids early in June, sew. disp. plant.—The A. H. Smith & Niles Co., Engr., 112 E. Woodruff, Toledo, Ohio.

Kan., Winfield—Contemp. start. wk. soon, sew. extn., est. $20,000 & dike wk. at consolidated mills; dike wk. to start May 1st.

Kan., Newton—Consider. constr. 2 sew. projs., est. cost, $50,000—City Comn., City Hall.

Minn., Rochester—Recommended for 1932, constr. san. relief sew., N. Broadway & 6th St. & constr. 15 in. sew. from 4th St. S. to S. line 6th St., SW.—A. F. Wright, Clk., City Hall (Charles H. Armstrong, City Engr.).

Okla., Elk City—Mar. 23d (abt.), sew. disp. plant, est. cost, $25,000.—W. E. Garrison, Clk., City Hall.

Tex., Dallas—Bids. rec'd. abt. Mar. 15th for Mill Creek outlet sew., cross. levee distr.; drain. of Mill Creek, Dallas Branch & Peak's Branch, est. cost, abt. $4,000,000.—W. W. Horner, St. Louis Consit. Engr.

Wis., Madison—Probably ready for bids June 1st for 3 mi. of sew. Nekoma Sew. Dist.—E. E. Parker, City Engr., City Hall.

Wis., Sheboygan—Council ordered Bd. pub. wks. to lay sew. in S. 10st St.—A. L. Boley, City Engr., City Hall.

Water Supply

Fla., Ormond—Contemp. lay water main extn. 800 ft. long to supply Ormond w. zone.—City Clk., City Hall.

Kan., Girard—Consider. install. water softener—City Comn., City Hall.

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Neb., Schuyler—Contemp. water supply improv., sink new well & add more modern pump. equip. for water plant.—c/o Clk., City Hall.

Ohio, St. Marys—Engrs. making surveys for water tower, 500,000 gal., est. $24,000, Auglaize Co.—Wilbur S. Hunter, Sen. Dir., City Hall (Froelich & Emery Co., Engrs., 2d Natl. Bank Bldg., Toledo).

O., Youngstown—Request $400,000, bond issue to take care of Water works extens. etc.—Geo. Turner, City Engr., City Hall.

Pa., Torrance—Plans being drawn for reservoir, Torrance Hospital, conc. lined earth.; est. cost $300,000.—Dept. of Property and Supplies (J. N. Chester Engrs., Engr., Clark Bldg., Pittsburgh).

Wis., Menomonee—Start wk. at once for dam, Wilson Creek.—F. W. Rowe, Clk., City Hall.

Bridges

Ill., Harrison—Plans approved for new brs. over Rock River, Byron & Oregon & over Pecatonica River at Harrison in Ogle Co.—O. F. Goeke, Dixon, Chf. of No. Ill. Div. of State Hwy. Dept. A.

Ia., Cedar Rapids—Contemp. constr. viaduct, 1st Ave. E. over Milwaukee trks. nr. Kenwood.—L. J. Storey, City Clk.

Ohio, Bucyrus—Prepar. plans & specs., br. across Sandusky River, W. Mansfield St., est. bet. $30,000 & $35,000, Crawford Co.—State Hwy. Dept., O. W. Merrell, Dir. (Columbus C. I. McNeal, Co. Engr.).

Ohio, Springfield—Complet. plans & specs., for 6 brs., over Chapman Creek, Newlove Rd., Tremont City Rd., Lower Snyderville Rd., Blee Rd. & Selma Pk.—Co. Comrs., Court House (Edwin R. Burke, Co. Engr.).

Ohio, Toledo—Ready for bids abt. Mar. 15th for subway S. H. No. 551, Lasky Rd. & Dixie Hwy., est. cost, abt. $400,000.—Dept. Hwys., O. W. Merrell, Dir., Columbus.

Wis., Ladysmith—Proj. approved by co. comrs. for br. over Flambeau on U. S. Hwy. 8, Flambeau Br. No. 1, est. $125,000. —State Hwy. Comn. (M. W. Torkelson, Act. State Hwy. Comn., Madison).

Wis., Milwaukee—Contemp. constr. 35th St. Viaduct across Menomonee Valley.—Dept. Publ. Wks., City Hall.

Wis., Whitehall—Contemp. for this yr., Hanson Br., Kamla Mill Br. & Moes Br.—State Hwy. Comn., M. W. Torkelson, Act. State Hwy. Engr., Madison & Wm. Mason, Trempealeau Co. Hwy. Comr., Whitehall.

Drainage and Irrigation

Mich., Adrian—Contemp. lay. out drainage dist. for Westgate drain, Raisin & Palmyra Twps., approx. 3 mi.—Hugh H. Hanna, Tecumseh Twp.

O., Toledo—Contemp. dredge Maumee River; est. cost bet. $300,000 and $400,000.—Port Commission, Otto Hohly, Ser. Dir.

Wis., Port Wing—Will start wk. in spring for dredg. harbor to bring channel to 15 ft. depth.—U. S. Govt., War Dept., Washington, D. C.

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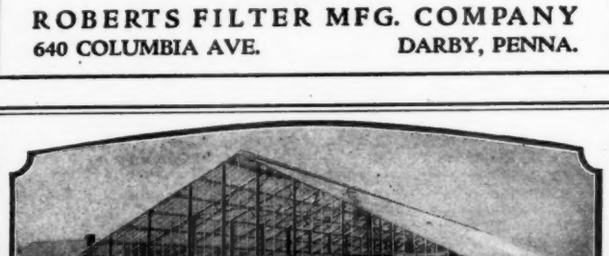

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terium aerogenes in Nature. I. In Decayed Stumps, Fred O. Tonney and Ralph E. Noble, pp. 433-446.

Journal of Bacteriology, Vol. 23, No. 1 (January, 1932.)

n107. A Note on the Use of Crystal Violet in Presumptive Tests for Water Pollution (Abstract), C. N. Stark and C. W. England, p. 36.

n108. Bacteria in Ocean Water and Sea Bottom and Their Role in the Cycle of Elements in the Sea, Selman A. Waksman and H. W. Reuszer, p. 42.

Journal of Hygiene (England), Vol. 32, No. 1 (January, 1932.)

109. The Classification of the Colon-Aerogenes Group of Bacteria in Relation to Their Habitat and Its Application to the Sanitary Examination of Water in the Tropics, H. J. Burke-Gaffney, pp. 85-131.

110. Significance of the Bacterium Aerogenes in Water, J. D. Allen Gray, pp. 132-142.

Müeller Record, Vol. 21, No. 233 January, 1932.)

n111. Leon Small, Water Engineer, Anon., p. 12.

n112. Water Works, Anon., p. 24.

Power, Vol. 75, No. 3 January 19, 1932.)

113. Making Water Measurements With Current Meters, Sigmund J. Bitterli, pp. 102-104.

Power, Vol. 75, No. 4 (January 26, 1932.)

114. Calculating Steam and Power Costs in Industrial Plants, Hugh J. Byrne, pp. 140-144.

Power, Vol. 75, No. 5 (February 2, 1932.)

115. Chlorine Treatment of River Water at Powerton Station, K. E. Stoll, pp. 168-170.

Power Plant Engineering, Vol. 36, No. 2 (January 15, 1932.)

n116. Heaters and Feed Water Conditioning Equipment, Anon., pp. 74-75.

Power Plant Engineering, Vol. 36, No. 4 (February 15, 1932.)

117. Corrosion Prevention in Ice Plants, Guy V. Thompson, pp. 167-169.

Proceedings of the American Society of Civil Engineers, Vol. 58, No. 1 (January, 1932.)

118. Public Supervision of Dams: Recommendations for Legislation and for Allications of Law, A. H. Markwart, pp. 20-27.

119. Public Supervision of Dams: Necessity for and Penalties for Lack of Supervision, M. C. Hinderlider, pp. 28-41.

120. Determination of Principal Stresses in Buttresses and Gravity Dams, W. H. Holmes, pp. 71-93.

121. Construction of La Ola Pipe Line in Chile, Discussion, W. B. Saunders, pp. 98-100.

Proceedings of the American Society of Civil Engineers, Vol. 58, No. 1 (January, 1932.)

122. Tests of Broad-Crested Weirs, Discussion, James G. Woodburn, pp. 101-107.

123. Run-off—Rational Run-off Formulas, Discussion, Clarence S. Jarvis, pp. 112-114.

124. Design of Large Pipe Lines, Discussion, a.) Paul Bauman, b.), L. J. Larson, pp. 115-116.

125. Soil Mechanics Research, Discussion, a.) Jacob Feld, b.), John R. Jahn, pp. 122-126.

Public Health News (N. J. State Bd. Health), Vol. 17, Nos. 1 & 2 (December, 1931, and January, 1932.)

n126. Iron Gives Bad Taste to Water, Anon., p. 21.

n127. Essential Features in the Design of Sanitary Drinking Fountains, Anon., p. 24.

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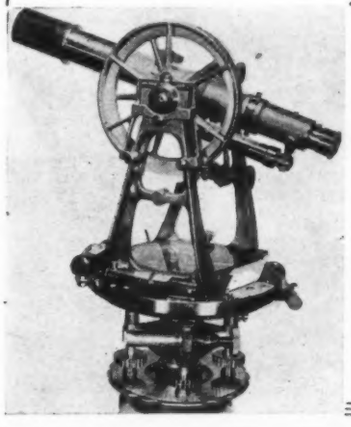

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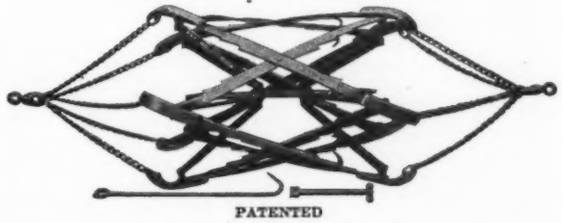

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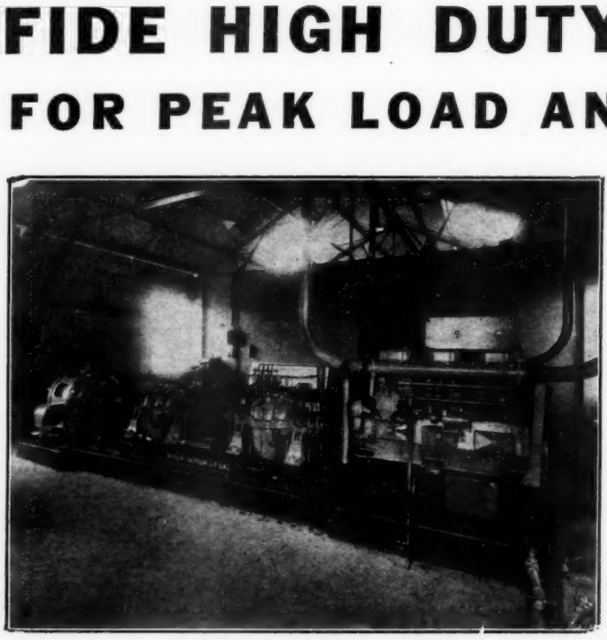

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A blade or rudder in front of the machine deflects the material in windrow, when necessary, to the V-shaped spreader blade or rough leveler "F," which splits the windrow and spreads the material out to the side runners, set to the desired width of road. It is easily adjusted by means of hand operated adjusting screws from 2″ to 8″ depth of material; also by a single adjustment it is possible to tilt the spreader blade "F" to provide a rough crown.

The rear final leveling plate or keying member "B" consists of bucking board and leveling plate, adjustable to crown varying from flat to 3″ by means of a single adjusting screw. This can be operated while machine is in motion. The advantage of this action is to allow constant change of crown while approaching or leaving flattened superelevated curves or flattened intersections. The height of the leveling plate "B" is regulated to different thickness of material by adjustable screw "G."

A pair of steel cables "C," approximately 300′ long and anchored at "D," are wound on two drums "E" at either side of the machine to pull it forward. The drums are operated at the same rate when working on the straightaway or can be operated independently when negotiating curves. After the cables are completely wound, the cables are again stretched along each side of the roadway and attached to an extra set of anchor plates, placed ahead of the one shown at "D," in which one or more stakes may be driven.

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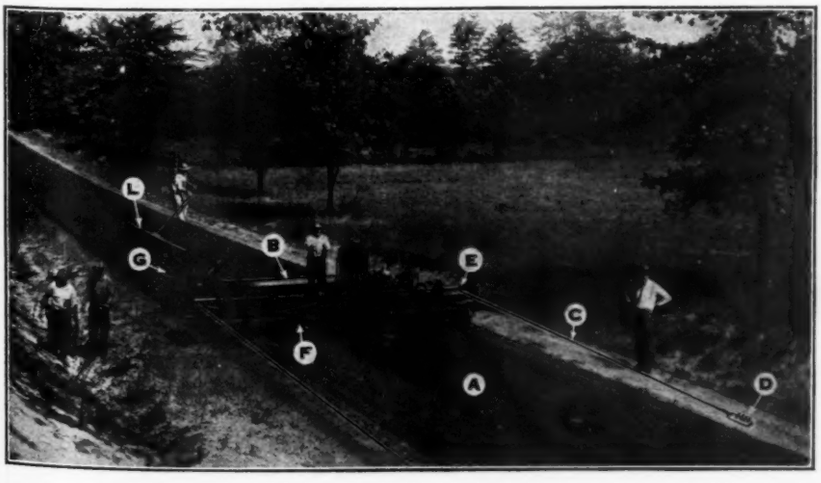

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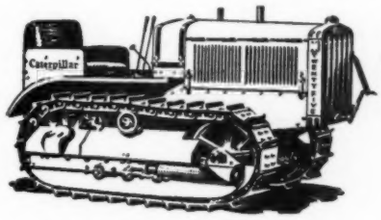
Another new model has been announced by Caterpillar Tractor Co., Peoria, Ill.—the "Twenty-Five." It develops 26 maximum drawbar horsepower. Its shipping weight is approximately 7,640 pounds. The engine is 4-cylinder, 4-inch bore and 5½-inch stroke. In general appearance, the Twenty-Five resembles other Caterpillars of about the same size.



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(Continued from page 13)

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105,263,157,894,736,842

And if this number is cut in two between the 9 and the 4, and the rear portion transposed to the front, you have the answer for the number ending in 9.

A mathematical solution to the problem is as follows:

y=number required.
a=base, exclusive of last figure 2.
n=number of digits in base a.

Then $a \times 10 + 2 = y$

$a + 2 \times 10^n = 2y$

Eliminating y

$20a + 4 = a + 2 \times 10^n$

or $19a = 2 \times 10^n - 4$

a is an integer, therefore

$$\frac{2 \times 10^n - 4}{19}$$

must be a whole number

Hence $2 \times 10^n - 4$, which is of the form 19999 . . . 6, must be a number exactly divisible by 19. The smallest number satisfying this condition is

$$\frac{2 \times 10^{17} - 4}{19} = a.$$

Solving we have y, the number, 105,263,157,894,736,842. This solution was sent in by J. K. Hoskins, but essentially similar answers were received from many others, including the following "honorable mention"

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701. *Road Machinery in Action.*—This interesting pictorial of 24 pages has just been published by Austin Western Road Machinery Co., Chicago, Ill. It pictures "in action" the entire Austin-Western line.

702. *Bay City Shovels.*—A new catalog, B1, has just been published by Bay City Shovels, Inc., Bay City, Mich. It contains specifications and illustrations of the new full-revolving Mode B, ⅝-yard convertible, which operates as a shovel, clamshell, trench hoe, dragline, etc.

703. *Caterpillars.*—Caterpillar Tractor Co., Peoria, Ill., has issued two new and interestingly characteristic pieces of literature: "Caterpillar Roads Are Good Roads" and "Tractors to Back Up Contractors."

704. *Auto Patrol.*—The Caterpillar Auto Patrol is described in a new booklet just issued by the Caterpillar Tractor Co., Peoria, Ill.

705. *Concrete Admix.*—The Barnsdall Tripoli Co., Exchange Bldg., St. Louis, Mo., has published a new 16-page pictorial bulletin No. F and also bulletin No. G, which describes the use of Barnsdall Admix as a workability agent and integral waterproofing for concrete, mortar, stucco and cement products.

706. *Aluminum and Its Alloys.*—Concise information concerning physical and chemical properties, and tables showing the sizes of the basic commodities manufactured from aluminum alloys, and commercial tolerances therefor. 64 pp. Aluminum Co. of America, Pittsburgh, Pa.

707. *Lubricated Valves.*—The Walworth Co., Boston, Mass., has published a catalog describing their line of lubricated plug valves for water, gas, air, tar and other liquids.

708. *Chrome-Nickel-Iron Pipe.*—Chemical and physical properties; recommendations for making up, cutting, threading and welding; and its use under varying conditions. Walworth Co., Boston, Mass.

709. *Venturi Meters.*—Builders' Iron Foundry, Providence, R. I., has issued a new book on the Venturi meter.

710. *Rex Road Maker.*—A notable booklet describing the new Rex 27-E paver, designed and built for 1932 conditions. It's worth reading. Write PUBLIC WORKS or the Chain-Belt Co., Milwaukee, Wis., for a copy.

711. *Tunnel Liner Plates.*—*Truscon* Co., Cleveland, O., has issued a descriptive catalog of Truscon steel liner plates for sewer and water tunnels, culverts, shafts and forms.

712. *"C" for Cement-Lined Pipe.*—American Cast Iron Pipe Co., Birmingham, Ala., has issued a new catalog which contains a table worked out for Acipco cement-lined cast iron pipe, for the valves of "C" applicable to the hydraulic tables of Hazen and Williams.

713. *Modern pH and Chlorine Control.*—This is a new 50 page booklet by W. A. Taylor and F. R. McCrumb. It contains a simple explanation of the meaning of pH control, a technical discussion of the subject, its application to more than thirty research and industrial problems and the approximate pH values of over one hundred acids, bases, foods, etc. It discusses modern practice in chlorine sterilization in the treatment of water, sewage, trade wastes, etc., and in the manufacture of food products as well as the bleaching of textiles, pulp, etc. W. A. Taylor & Co., Inc., 872 Linden Ave., Baltimore, Md.

Construction Materials and Equipment

Accessories for Motor Trucks

1. Truck accessories—winches, power take-offs, derricks, special bodies, earth boring machines, and trailers of all capacities. Dept. B, Four Wheel Drive Auto Company, Clintonville, Wisconsin.

Asphalt Heaters

8. A 32-page general catalog issued by Littleford Bros., 452 E. Pearl St., Cincinnati, Ohio, describes and illustrates their complete road maintenance line, including tar and asphalt kettles, surface heaters, oil burners, sand dryers, tool boxes, lead and compound furnaces, tool heaters, asphalt tools, joint and crack fillers, squeegee carts, etc.

9. Illustrated manual No. 11 describes "Hotstuff," the master oil burning heater. The only heater with patented elevated melting chamber for Asphalt, Tar and all bitumens used in road and street construction and maintenance, roofing, water proofing, pipe coating, etc. Mohawk Asphalt Heater Co., 94 Weaver St., Schenectady, N. Y.

Asphalt Plants

10. Portable Asphalt Paving Plants. These R. R. 1-car plants have easy capacity of 2,250 yards, 2" surface per 8 hours. Cheap to operate. J. D. Farasey Mfg. Company ,Cleveland, Ohio.

Asphalt Rollers

12. How to use Rollers to Save Tamping Costs. 16-page booklet gives details and also specifications of the Erie Roller. Issued by the Erie Machine Shops, Erie, Pa.

Bins and Hoppers

20. The Owen Bucket Company, Cleveland, Ohio, have available illustrated folders on Material Handling Buckets, showing the various types, sizes and uses for which they are intended and construction features and other valuable bucket information. A complete catalog on all types of Material Handling Buckets will also be furnished on request.

Bituminous Road Paver

25. Specifications and description of new Paver that gathers, proportions, mixes, spreads and compacts bituminous road in one continuous operation offered by Barber-Greene Co., 635 West Park Ave., Aurora, Ill. Ask for Bulletin BPF.

Clamshell Buckets

27. Clamshell Buckets, showing the various types, sizes and uses for which they are intended, and construction features and other valuable bucket information. A complete catalog on all types of Clamshell Buckets will also be furnished on request. The Owen Bucket Company, Cleveland, Ohio.

Concrete Accelerators

30. "How to Cure Concrete," a forty-seven page manual published by the Dow Chemical Company, Midland, Michigan, treats fully subjects suggested by title.

31. "Curing Concrete Roads with Solvay Calcium Chloride," 30 page booklet. Comprehensive. Contains tables, illustrations, suggestions for testing devices. Covers the subject in considerable detail. Solvay Sales Corp., 61 Broadway, N. Y. C.

35. "A report on Current Practice of using Calcium Chloride for curing Concrete Pavements, Bridges, Culverts and Concrete Products." It includes reports from the Highway Research Board, the Bureau of Public Roads and State Highway Departments. Columbia Products Co., Barberton, Ohio.

Concrete Handling

40. Pouring concrete with portable and permanent belt conveyors on bridges, dams, buildings, locks, sewers, tunnels, etc., is described in a generously illustrated booklet, "CONCRETE HANDLING," by Barber-Greene Co., 635 West Park Ave., Aurora, Ill.

Concrete Mixer

44. Concrete Mixers, both Tilting and Non-Tilting types, from 3½s to 84s size, The Jaeger Machine Company, Columbus, Ohio.

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3-32

Crushers

57. Up-to-date information on Stone Crushers, Stone Spreaders, Unloaders, Drags and other contractors' equipment from the Gallon Iron Works & Mfg. Co., E. Jeffry, Mfg. Co., Columbus, Ohio.

Excavating Buckets

73. Excavating Buckets — shows the various types and sizes, the uses for which they are intended, construction features and other valuable bucket information. A complete catalog on all types of Excavating Buckets will also be furnished on rerequest. The Owen Bucket Company, Cleveland, Ohio.

Finishing Machines and Screeds

75. High Speed Screeding and Finishing—the use of single and tandem screeds and tamper attachment for high speed production on concrete and bituminous pavements, city streets and highways—32 pages. The Lakewood Engineering Company, Columbus, Ohio.

Graders

77. "Blade Graders" is a 48 page booklet, recently published by the Caterpillar Tractor Co., Peoria, Ill., giving the complete details of "Caterpillar" graders.

78. The No. 101 Austin Leaning Wheel Grader is completely detailed and illustrated in Bulletin No. 1238 which shows operation of Z-Bar, back sopper, bank cutter, etc. Published by The Austin-Western Road Machinery Co., 400 North Michigan Ave., Chicago.

79. Austin No. 77 Dual Drive Motor Graders are completely illustrated and described in Bulletin No. 1239 which also contains construction details, specifications and weights. Austin-Western Road Machinery Co., 400 North Michigan Ave., Chicago.

Hose and Belting

87. Complete information on rubber hose and belting for all types of contracting and road building service. The Government Sales Department of the Goodyear Tire & Rubber Co., Inc., Akron, Ohio.

Joint Filler and Line Marker

88. Bulletin No. G-9 issued by Littleford Bros., 452 E. Pearl St. Cincinnati, Ohio, describes and illustrates their new No. 91 Joint Filler which is used to fill horizontal and center joints with hot asphalt. It can be equipped to apply an asphaltic center line as it fills the center joint. This bulletin also describes the Littleford Traffic Line Marker.

Joint Filling Pot

89. A supplement to Bulletin No. E-5 has been issued by Littleford Bros., 452 E. Pearl St., Cincinnati, Ohio, describing their cone-shaped crack filling pot No. 86-B. The chief feature of this pot is that it is springless—there is no mechanism to get out of order. It is used to fill cracks and joints in concrete pavements and interstices in brick or granite block pavements.

Lanterns and Torches

90. Dietz Lanterns and Road Torches adapted for night traffic warning on any construction work that obstructs the highways. R. E. Dietz Co., 60 Laight St., New York, N. Y.

Loaders and Unloaders

97. Portable Loaders and Unloaders. Folders: Nos. 1073 and 1074 cover Belt Conveyors with channel iron and truss types of framework; No. 1076, Portable Bucket Elevators for different classes of work; and No. 1149, the "Grizzly" Crawler Loader for heavy work and large capacities. Link-Belt Company, Philadelphia.

100. Materials Handling and Positive Power Transmission Equipment, giving technical data, list prices and illustrations of this machinery. Link-Belt Co., Chicago, Ill. General Catalog No. 500.

Motor Trucks

107. "Operating Records for Motor Trucks" is one of the most complete record books available. It includes the necessary forms and directions for a very accurate and detailed accounting of Motor Truck operations. Dodge Brothers Corp., Detroit, Mich.

108. Four-wheel-drive trucks increase the range of truck operation and are particularly adapted for economy of operation in road building and maintenance. Dept. B. Four Wheel Drive Auto Company, Clintonville, Wisconsin.

Paving Materials

109. A 36-page booklet with 66 illustrations has just been issued by the Barrett Co., giving full information regarding the making, laying and maintaining of "Tarvia-lithic," the ready-to-lay pavement.

111. "Tarvia Double Seal Pavements." Shows, step by step, the construction of a Tarvia pavement. 24 pages. The Barrett Company, 40 Rector Street, New York.

112. Complete directions for surface Cut Back Asphalt are contained in a 36 treatment and bituminous surfacing with page data book. Standard Oil Co. of Indiana, 910 So. Michigan Ave., Chicago, Ill.

Road Construction

121. "Road Construction and Maintenance" takes up such subjects as modern methods of handling large capacity equipment, tandem equipment, etc. Cleveland Tractor Co. 1932 Euclid Ave., Cleveland, Ohio.

122. "Road Building Machines" is a handy reference booklet to the complete line of "Caterpillar" road machinery. 40 pages.

Road Machinery

125. The following publications cover a wide range of valuable and useful information on road-building machinery. Sixty Leaning Wheel Grader, the Super-Special Grader, the Motor Patrols, the Twenty-Planer, the Hi-Way Patrol Grader No. 3, the Ten Motor Patrol, and the Auto Patrol. Caterpillar Tractor Co., Peoria, Ill.

126. A new picture book of the Austin-Western Line of road machinery showing the application of road graders, road rollers, elevating graders, crawler and wheeled wagons, crushing and screening plants, shovels, cranes and excavators, scarifiers and many small tools, is contained in Catalog No. 1247. Copies available on request at The Austin-Western Road Machinery Co., 400 North Michigan Ave., Chicago.

127. "Road Machinery Illustrated." New illustrated bulletins on the motor rollers, three-wheel and tandem rollers, motor graders powered by Caterpillar, Twin City, Cletrac. McCormick-Deering and Fordson tractors, and straight and leaning wheel graders. Gallon Iron Works & Mfg. Co., Gallon, O.

Elevating Graders

129. An interesting booklet on Elevating Graders has recently been issued by the Caterpillar Tractor Co., Peoria, Ill.

Rollers

131. A 16-page booklet printed in two colors gives full details and specifications of the Erie Roller. Also explains how to use it to save tamping costs. Numerous action pictures. Erie Machine Shops, Erie, Pa.

132. A 32-page book in four colors featuring a complete line of road rollers. 8¾ x 11, leatherette cover, numerous action pictures. Buffalo-Springfield Roller Co. of Springfield, Ohio.

133. 20-page pocket size booklet showing all types of Buffalo-Springfield motor rollers and scarifiers and their uses. The Buffalo-Springfield Roller Company, Springfield, Ohio.

134. "Road Rollers." Illustrated booklets covering the entire line of Master 4-Cylinder motor roller, 4-cylinder tandem roller and International motor roller. Gallon Iron Works and Manufacturing Co., Gallon, O.

135. 36-page, illustrated book describing the application of Motor Rollers to many types of road construction and maintenance. Huber Mfg. Company, Marion, Ohio.

136. Full description of Huber Motor Rollers in sizes from 5 to 15 tons, included in durable 36-page book for use by road contractors and maintenance crews. Huber Mfg. Co., 345 E. Center St., Marion, Ohio.

Sand and Gravel Buckets

137. The Owen Bucket Company, Cleveland, Ohio, have available illustrated folders on Sand and Gravel Buckets showing the various types, sizes and uses for which they are intended. A complete catalog on all types of Sand and Gravel Buckets will also be furnished on request.

Sand and Gravel Washing Plants

140. Seventy-page catalog giving complete information regarding Sand and Gravel Washing Plants, stationary and portable. Those interested in such equipment should have a copy. Link-Belt Co., Chicago, Ill.

Shovels, Cranes and Excavators

145. The Austin Badger, a new, fully convertible ⅜ yard crawler shovel, made by The Austin-Western Road Machinery Co., 400 North Michigan Ave., Chicago, is fully described and illustrated in their Bulletin No. 1236.

146. Link-Belt Co., Chicago, Ill., has issued Book No. 1095, which describes and illustrates their complete line of Gasoline, Electric, or Diesel operated shovels, cranes and draglines.

151. Lifting capacities and working ranges for the different sizes and types of the complete line of ½-yd. to 1½-yd. shovels, cranes, draglines, ditchers and skimmers. Orton Crane & Shovel Co., 608 S. Dearborn St., Chicago, Ill.

Steel Posts

160. Steel Posts for highway guard rails, fences and other purposes. Catalog and data book. Sweet's Steel Company, Williamsport Pa.

Surveying Instruments

163. A complete catalog and instruction book pertaining to the "Sterling" transits and levels are described and illustrated in a 64-page booklet. Warren-Knight Co., 136 No. 12th St., Philadelphia, Pa.

164. A 140-page manual of engineering and surveying instruments covering levels, plane tables, transits, current meters and supplies, such as hand levels, barometers, etc. C. L. Berger & Sons, Inc. ,37 Williams St., Boston, 19, Mass.

Tires, Truck and Tractor

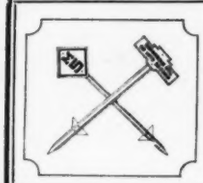
165. Speed and economy in use of solid, cushion and pneumatic tires and tubes for trucks, cars, tractors, graders and other road machinery. Government Sales Department of the Goodyear Tire & Rubber Company, Inc., Akron, Ohio.

Tool Boxes

167. Bulletin No. G-6 issued by Littleford Bros. 452 E. Pearl St., Cincinnati, Ohio, describes and illustrates the Han-DeeBox, a portable tool box of all-steel construction. This tool box is equipped with a special locking device that locks both covers at the same time. No padlocks are used. Littleford trailers, lead melting furnaces, and "Hot Dope" Kettles for pipe coating are also described in this bulletin.

Tractors, Crawler

169. The use of crawler tractors in roadbuilding and maintenance, earth moving, excavating, grading, snow removal, oil field work and lumbering. Made



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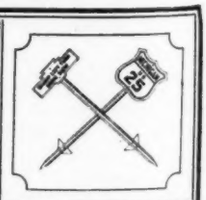
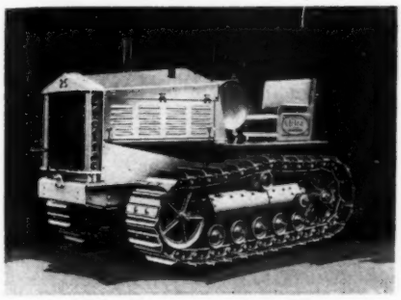
STEEL POSTS



New Cletrac Twenty-Five

Among the points about this new Cletrac that deserve special mention are: It is equipped with a Hercules 6-cylinder motor, and it has electric starting and battery ignition as standard equipment. The draw-bar horsepower is 27; the weight about 6,725 pounds.



Cleveland "25" Tractor

Western Portable Crushing and Screening Plants

To meet the growing demand for larger capacity units, capable of reducing rock and pit run gravel to small sizes, two new Western Portable Crushing and Screening Plants have been developed by the Austin-Western Road Machinery Co. Coupled with this demand for greatly increased capacity is the limiting factor that the plant as a whole must be of a size that can be transported readily from one location to another.

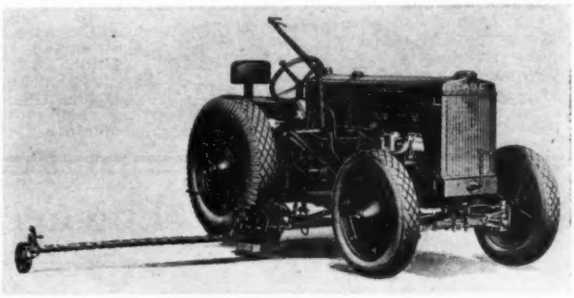
The new Western No. 100 and No. 90 Plants combine capacity, compactness, and portability. The overall height is under 12 feet; the overall length, exclusive of the pit conveyor, is under 26 feet, and the overall width, exclusive of the delivery conveyor, is under 10 feet.

The amount of over-size in gravel pits varies greatly, and the new Western unit is therefore designed to accommodate either a single crusher or both primary and reduction crushers. The two-crusher plant is known as the No. 100, while the single crusher plant is known as the No. 90. A two deck screen is used in the No. 100 Plant and a single-deck screen in the No. 90. With the exception of the crushers and screens the two plants are practically identical. In a pit where there is but a small percentage of over-size, the No. 90 Plant is adequate, but it always is possible to install the second crusher should the percentage of over-size increase.

When moving from one location to another it is only necessary to disconnect the pit and delivery conveyors. The operation is still further simplified by the fact that there is no projection below the ground level at any time. It is not necessary to dig a pit for the lower end of the delivery conveyor, and the unique bucket carrier, which returns the crushed material to the screen, also operates entirely above the ground line.

New Power Mower for Case Tractor

This new Case power mower is especially designed for the heavy duty work required in highway mowing. The easily controlled vertical lift, rear power take-off drive through double "V" belt, and numerous safety features all commend themselves to the highway operator. It is easily mounted on Case Model "CI" Tractors and also can be quickly detached. Without turning his head, the operator can at all times see the uncut grass ahead and watch the work being done by the cutter bar.



Case Power Mower and Tractor

The White Level-Transit for Engineers and Contractors

New and Improved Level-Transit

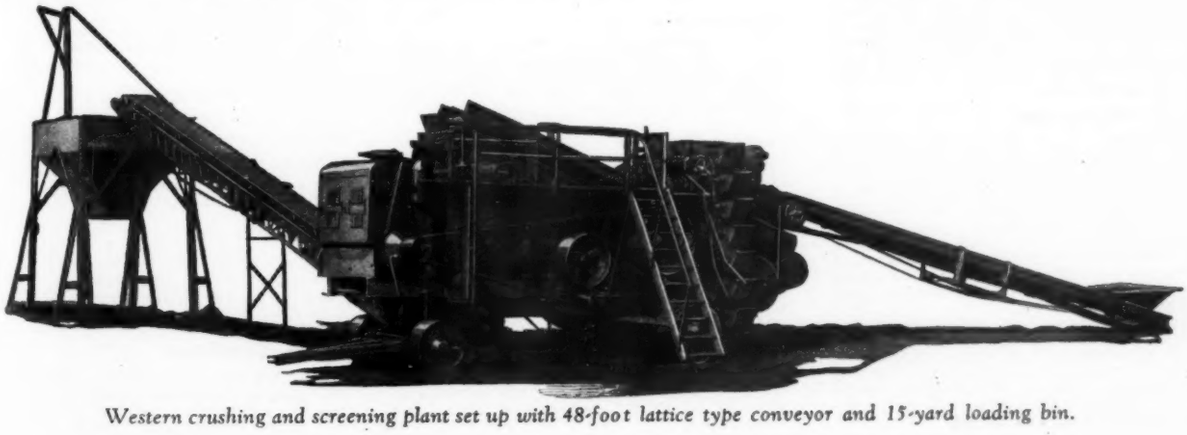
A specially designed "Level-Transit" for the highway engineer or contractor is announced by the David White Company, Inc., Milwaukee, Wis. An important improvement is the unusual strength and construction of the standards which are cast in one piece around the upper body. This construction insures that the instrument will withstand much rough handling and still stay in adjustment.

The telescope has a magnifying power of 25 diameters which enables the reading of a rod at a distance of approximately 1000 feet. It is also possible to take a focus as close as 4½ feet from the center of the telescope.

This frequently saves time in many types of work.

In order to change the instrument from level to transit, it is only necessary to release the two levers. It is equipped with a vertical arc so that the angles above and below the horizontal plane can be easily read. A large shifting center permits the instrument to be moved in any direction over a point without disturbing the adjustment.

An interesting booklet has been prepared for the contractor and the builder entitled "How To Lay Out Building Lots Accurately." This booklet will be sent upon request.



Western crushing and screening plant set up with 48-foot lattice type conveyor and 15-yard loading bin.

in "20," "30," and "40" and "100" sizes. Bulletin 562. Cletrac crawler tractors. Cleveland Tractor Co., 19322 Euclid Ave., Cleveland, O.

171. The design, construction, details and complete specifications of the Ten and Fifteen models "Caterpillar" are given in a booklet published by the Caterpillar Tractor Co., Peoria, Ill.

172. The Caterpillar Sixty Tractor. This beautifully illustrated booklet tells the story of the Caterpillar Sixty Tractor design and construction. Caterpillar Tractor Co., Peoria, Ill.

173. Cletrac Crawler Tractors are built in a complete line ranging in size from the 12 h. p. model to the powerful 100 h. p. tractor. The Cleveland Tractor Company, 19322 Euclid Ave., Cleveland, Ohio.

175. Caterpillar Tractors. The "Fifty;" the "Thirty-five;" the "Twenty-five." Full data on these models. Caterpillar Tractor Co. Peoria, Ill.

Road and Street Maintenance

Asphalt Heaters

200. For general construction and maintenance, the Original Improved "Hotstuf" Asphalt Heater, an economical oil burning heater. Mohawk Asphalt Heater Co., 56 Weaver St., Schenectady, N. Y.

201. Full data on tar and asphalt kettles, oil burning kettles, pouring pots, torches and hand spraying attachments. Connery & Company, Inc., of Philadelphia.

205. The latest and improved style "J" Oil Burning Kettle for Paving Contractors, Street and Highway Departments. Connery & Company, Inc., 3900 N. Second St., Philadelphia. Pa.

8. A 32-page general catalog issued by Littleford Bros., 452 E. Pearl St., Cincinnati, Ohio, describes and illustrates their complete road maintenance line, including tar and asphalt kettles, surface heaters, oil burners, sand dryers, tool boxes, lead and compound furnaces, tool heaters, asphalt tools, joint and crack fillers, squeegee carts, etc.

Dust Control

210. "How to Maintain Roads," by the Dow Chemical Company, Midland, Michigan, is a manual dealing thoroughly with dust control, road building and maintenance.

211. "Dust Control," a concise, handy pocket reference on control of dust by use of 3C Calcium Chloride. Illustrated. Issued by the Columbia Products Company, Barberton, Ohio.

Dust Laying

213. Full information regarding the use of Solvay Calcium Chloride for effectively laying dust. The booklet, "Solvay Calcium Chloride, a Natural Dust Layer," 24 pages, 5½x8, covers application, economies, etc. Sent without cost. Solvay Sales Corporation, New York.

Emulsion Sprayers

214.—A complete line of emulsion sprayers is described in Bulletin No. G-5 recently issued by Littleford Bros., 452 E. Pearl St., Cincinnati, Ohio. Littleford Emulsion Sprayers will spray any type of asphalt emulsion used for penetration patch work or curing concrete. They are also used to spray silicate of soda and weed exterminators.

Highway Maintenance

215. "Road and Street Maintenance Equipment," a compact vest pocket manual containing illustrations and brief descriptions of their extensive line. Littleford Bros., 452 East Pearl St., Cincinnati, Ohio.

216. "Light and Heavy Road Maintenance" describes fully the FWD truck and its economy for use in pulling road graders and maintainers—issued by Dept. B, Four Wheel Drive Auto Company, Clintonville, Wisconsin.

218. "Maintenance Machines," a 32 page booklet, tells of "Caterpillar's" complete line of maintenance machines—3 sizes of motor patrols, a trailer patrol and planer—including machines to fit all pocketbooks and all road maintenance conditons. Caterpillar Tractor Co., Peoria, Ill.

Highway Maintenance

219. "Tarmac C P (Cold Patch)." Valuable information concerning the varied uses and methods of application of cold mix for repairs and surfacing, together with many actual photographs. Koppers Products Company, Koppers Building, Pittsburgh, Pa.

Surface Heaters

225. The "Hotstuf" three in one, combination Tool, Asphalt and Surface heater is described and its use illustrated in Bulletin 16. Mohawk Asphalt Heater Co., 56 Weaver St., Schenectady, N. Y.

Road and Paving Materials

Bituminous Materials

226. "Mixed - in - Place Construction." Step-by-step pictures and specifications for constructing road surfaces by Retread or Turnover methods. American Tar Products Co., Koppers Bldg., Pittsburgh, Pa.

227. "Asphalt for Every Purpose," a 44-page illustrated booklet describing Stanolind Asphalt products. Standard Oil Co. of Indiana, 910 So. Michigan Ave., Chicago, Ill.

228. "Tarvia." An attractively illustrated 32-page booklet describing grades of Tarvia and showing photographs of actual application. The Barrett Company, 40 Rector St., New York City.

Brick, Paving

230. Full information and data regarding the use of vitrified brick as a paving material, cost, method of laying, life, etc. National Paving Brick Manufacturers' Association, National Press Building, Washington, D. C.

Concrete Curing

235. "How to Cure Concrete," is a manual of instruction on the curing of concrete pavements. 47 pages. The Dow Chemical Company, Midland, Mich.

Maintenance Materials and Methods

270. "How to Maintain Roads," by the Dow Chemical Company, Midland, Michigan, is a manual dealing thoroughly with road building, maintenance and dust control.

275. "Tarvia-K. P. for Cold Patching." An instructive booklet illustrating and describing each step in patching a road wth "Tarvia-K. P." 16 pages, illustrated, 3½x9. The Barrett Company, New York.

276. "Road Maintenance with Tarvia." A 56-page illustrated booklet of value to every road man. Shows how almost every type of road and pavement can be repaired and maintained with Tarvia. The Barrett Company, New York.

277. "Surfacing with Tarmac." A concise booklet describing methods and advantages of using Tarmac in prime coating, surface treatments, re-treatment, penetration, mixed-in-place, etc. Koppers Products Company, Koppers Building, Pittsburgh, Pa.

Snow Removal

Snow Removal

348. "Winter Maintenance" is the title of a booklet which illustrates many types o fsnow plows and methods of handling snow removal problems. Dept. B, Four Wheel Drive Auto Company, Clintonville, Wisconsin.

349. "The Answer to the Snow Removal Problem." It gives full details of the Frink type S snow plow for trucks. Carl Frink, Mfr. of Clayton, N. Y.

353. Efficient methods of combating quickly the snow menace on highways and city thoroughfares. The Cleveland Tractor Co., 19322 Euclid Ave. Cleveland Ohio.

354. "Snow Removal Equipment" pictures various types of snow-fighting equipment built for "Caterpillar" Tractors are pictured in relief and in action. Caterpillar Tractor Co., Peoria, Ill.

355. "Conquering Snow With Caterpillars." "An Unwelcome Visitor Is Coming." "A Wall Ten Miles High." Three publications on the snow problem by the Caterpillar Tractor Co., Peoria, Ill.

358. Complete data for selecting the proper size snow plow for your particular make and model of truck. Carl H. Frink, Clayton, N. Y.

359. Galion Iron Works and Mfg. Co., Galion, Ohio. Details, prices and catalogs of their snow plows adaptable to any make of truck.

Sanitary Engineering

Activation and Aeration

390. A booklet of value to sanitary and chemical engineers describes Norton Porous Mediums of bonded fused alumina (strong chemically stable, uniformly permeable) and their use in aeration of water and sewage. Norton Co., Worcester, Mass.

Glass-Overs

393. Full details regarding the use of Lord & Burnham Glass-Covers at Dayton, Ohio; Highland Park, Ill.; Fostoria, Ohio; and Bloomington, Ill. are given in bulletins Nos. 10, 11, 14, 15. Issued by Lord & Burnham, Graybar Bldg., New York, N. Y.

Incinerators

396. "Pittsburgh-Des Moines Incinerator," built and guaranteed by the Pittsburgh-Des Moines Steel Company, 3479 Neville Island, Pittsburgh, Pa. Booklet on request.

Jointing Materials

401. G-K Compound for vitrified clay sewers, MINERALEAD for bell and spigot water mains, also M-D Cut-Ins for making house connections. Atlas Mineral Products Company, Mertztown, Pennsylvania.

402. Full details concerning No. 1 Korite for sealing sewer pipe joints so that they will be permanently tight. Standard Oil Co. of Indiana, 910 So. Michigan Ave., Chicago, Ill.

403. An illustrated folder has just been issued by the Cochrane Chemical Co., 432 Danforth St., Jersey City, N. J., detailing the advantages and the savings in the use of Ex-XL-cell Sewer Pipe Joint Compound.

Manhole Covers and Inlets

404. Cast iron sewer blocks, ventilators, manhole covers and inlets, valves, etc., described in pamphlet by the South Bend Foundry Co., South Bend, Ind.

Pipe, Cast Iron

406. "Data Book"—Cast Iron Pipe and Fittings, sizes 1¼ through 12 inches, either with or without Precaulked lead joints factory-made in the bells. The McWane Cast Iron Pipe Co., Birmingham, Ala., and Provo, Utah.

407. "Handbook of Cast Iron Pipe" contains useful tables and data for the Water Works man on pipe line construction, weights and dimensions. U. S. Cast Iron Pipe and Foundry Company, Burlington, N. J.

Pipe Line Construction

410. Pipe Lines and the Caterpillar. In this 32-page booklet are pictured many uses of the Caterpillar Tractor, and ways in which they can be applied to the saving of men, money and minutes. The Caterpillar Tractor Co., Peoria, Ill.

Pumping Engines

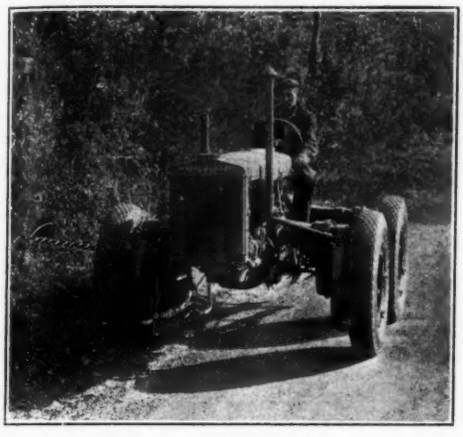
413. "When Power Is Down," gives recommendations of models for standby services for all power requirements. Sterling Engine Company, Buffalo, N. Y.

Pumps, Centrifugal

415. Design data for centrifugal pumps for high or low service pumping for waterworks and filtration plants. Dayton-Dowd Co. Mfrs. Centrifugal Pumps. Quincy, Ill.

Massey-Harris Mower

The Massey-Harris power mower has been designed to give the heavy duty service that a mower must encounter when used for cutting weeds and brush that are found along shoulders of highways and on railroad right-of-ways. The extreme flexibility of the Four Wheel Drive tractor permits the head of the cutter bar to always remain in contact with the ground.



The location of the cutter bar gives the tractor operator a clear view of the ground, ahead of the sickle, consequently preventing the striking of solid obstructions.

This mower is a product of the Massey-Harris Co., Racine, Wisc.

A New Tape-Rule

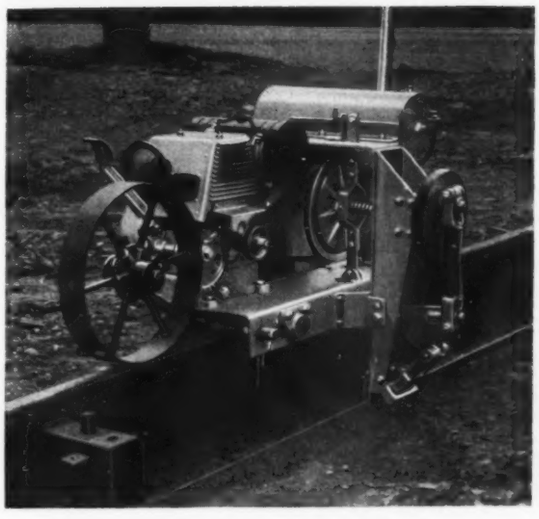
"Crescent Junior," a smaller and lighter weight tape-rule, is announced by The Lufkin Rule Co., Saginaw, Michigan. It has the flexible and rigid features (both so handy in measuring),

The Lufkin Crescent Rule

yet is no larger than a watch. It is automatic wind and made in two lengths, 4 and 6-foot. The blade is 7-16″ wide and can be projected unsupported to walls or into openings like a rule. Will also accurately measure circles and odd shapes. Made of superquality tempered steel, stiffened by special forming. Has dark background with markings in sharp contrast, most readable. Graduated inches to 16ths. Zero falls at inside of solid hook, a very handy feature, and just the thing for taking measurements out of arms reach. Accurate butt end measurements can be taken from the shoulders of the hook.

Lakewood Form Tamper

The Lakewood Form Tamper is an easily portable machine that can be handled by one man. It secures a smoother pavement by insuring a thorough tamped base, thereby eliminating possible form settlement under present day subgrade shaping and concrete placing equipment. Experiments prove 33% less settlement under mechanical tamping than with hand-tamped forms.



Left: The Massey-Harris Power Mower. Right: The easily portable Lakewood Form Tamper.

Once started, the Lakewood Form Tamper travels on the forms at a speed of 25 feet per minute, requiring no further attention until stopped, and oils the inside face of the forms. Inclined tampers, one on each side, compact the earth under the forms at the base.

Adjustments are provided to care for 7″ to 10″ heights and base widths of forms now in use. Its use will reduce the amount of final finishing on the concrete slab.

Gramm Special Cab Equipment

Gramm Motors, Inc., Delphos, Ohio, have announced the use of Gramm Comfort Cab equipment. This consists of a hot water heater; safety laminated glass in windshield and all windows; lighter for cigars, cigarettes or pipe; windshield defroster and electric clock.

These items are not actually required for the operation of the truck but nevertheless are very much to be desired by the driver. Gramm Motors, Inc. are of the opinion that the driver is entitled to the same accessories for his convenience when driving a truck as when operating his own car.

The development of Colas has been proceeding with such rapidity that arrangements have recently been completed enabling the marketing of the product to be undertaken on a more intensive scale. The holding company, Colas Roads, Inc., of which I. J. Harvey, Jr., is President, has issued licenses to five companies, all of them associated with the Shell group, and each having a complete distributing organization in their respective territories.

In the eastern States Colas will be handled by Shell Eastern Petroleum Products, Inc., of 122 East 42nd Street, New York City, with J. S. Sawyer, formerly General Manager of Colas Roads, Inc., in charge of the Asphalt Division. In the Middle West a license has been granted to the Shell Petroleum Corporation, Shell Building, St. Louis, Missouri, and Colas sales in this territory will be under David Waxman, Manager of the Asphalt Sales Dept. In the West the Shell Oil Company, Shell Building, San Francisco, has been promoting Colas for the past two years and this company will continue to do so under the new arrangement. This company also covers Western Canada through its subsidiary, the Shell Oil Company of British Columbia, Ltd.

The remainder of Canada is operated by Colas Roads, Ltd., with offices at 712 Daily Star Building, Toronto, Ontario, and at Montreal. This territory is under the management of R. G. Wace. In Mexico Colas is handled by the Compania Mexicana El Aguila S. A. of Mexico under the direction of Allen Payne.

Colas factories are in operation at New Orleans, Louisiana; Chicago Heights, Illinois; Rutherford, New Jersey; Martinez and Los Angeles, California; Montreal, Quebec; Brantford, Ontario, and Tampico, Mexico; in addition to which the erection of further plants is projected at other points. The world wide use of Colas is indicated by the fact that there are now no less than 80 Colas plants in operation.

The Allis-Chalmers Tractor Division will manufacture a complete line of graders, having purchased the line of graders built by the Ryan Manufacturing Co., of Chicago. The grader line will be manufactured at LaPorte, Indiana, in the Advance-Rumely plant which was recently acquired by Allis-Chalmers.

The Ryan line consists of leaning frame, leaning wheel blade graders in three sizes and a motor patrol unit. These graders will supplement and round out the line of Track-type Tractors, Industrial Wheel type Tractors and Industrial equipment now marketed through Allis-Chalmers dealers.

Pumps—Sewage

417. Non-clog vertical and horizontal sewage pumps and their characteristics are described and illustrated in bulletins of the Dayton-Dowd Co., Quincy, Ill.

Screens, Sewage

418. Sewage screens (Tark, Brunotte, and Straightline) for fine and coarse sewage; Straightline Collectors for Settling Tanks (Sludge, Scum and Grit), and Mechanical Aerators for activated sludge plants. Link Belt Company, 910 So. Michigan Ave., Chicago, Ill. Book 642.

Screens

420. Water Screen Book No. 1252, describes water screens and gives complete technical information about them. Link-Belt Co., Chicago, Ill.

Sludge Bed Glass Covers

425. Folder, standard filling size, contains model set of specifications and 11 x 17 inch drawings showing standard sizes and construction details of King Glass Enclosures for sewage treatment plants. King Construction Co., 539 Wheatfield St., North Tonawanda, N. Y.

426. Sludge Bed Glass Covers—"Super-Frame" Hitchings & Co., Main Office, Elizabeth, New Jersey. Offer A. I. A. File 101SB, describing glass covers for sludge and sprinkler beds; details, specifications and cost data.

427. Bulletin GE31 describes Glass Enclosures for Sludge Beds in detail. Specifications, cross sections, details and illustrations shown are of value to engineers and officials. Sent promptly upon request. American-Moninger Greenhouse Mfg. Corp., Dept. B, 1947 Flushing Ave., Brooklyn, N. Y.

Sewer Maintenance

428. "The Expanding Root Cutter and Sewer Cleaning Method," a 32-page booklet prepared by the Expanding Sewer Machine Co., Nappanee, Ind., gives full details as to methods and equipment needed for sewer cleaning.

Sludge Treatment

430. Downes Floating Covers and Sludge Digestion Equipment. The Pacific Flush Tank Co., 136 Liberty St., New York, N. Y. Contains photographs of installations of floating covers and technical data on the subject.

Treatment

432. Eight separate catalogs on Sewer and Sewage Disposal Automatic Equipment, including pumps, Imhoff Tanks and Sewer Joint Compounds. The Pacific Flush Tank Company of Chicago and New York.

433. Collectors and concentrators for modern sewage treatment plants, recent installations, and full data on aerators, and screens. Link Belt Co., 910 So. Michigan Ave., Chicago, Ill. and Philadelphia.

Valves

436. Data Book on Bronze and Iron Valves for service on Steam, Water, Gas, Gasoline, Air and Oil lines. The Fairbanks Company, 393 Lafayette Street, New York, N. Y.

Water Development

440. Complete details of the Layne System of water development for municipalities and irrigation projects, based on deep wells and turbine pumps. Layne & Bowler, Memphis, Tenn.

Water Storage

442. "Modern Water Storage" contains 28 pages of reliable information, interesting photographs, authentic engineering data and "Pittsburgh-Des Moines" specifications on various types of elevated tanks, penstocks, pipe lines, stand pipes, steel reservoirs, treating plants and complete water systems.

Miscellaneous

Airport Construction

595. Airports and Airways. A 20-page illustrated booklet by the Caterpillar Tractor Co., Peoria, Ill., describes the uses of tractors in building airports and handling planes.

597. "Getting on the Air Map With 'Caterpillar,'" describes the many uses of the tractor in building and maintaining airports better, quicker, cheaper. Caterpillar Traction Co., Peoria, Ill.

Chains and Speed Reducers

607. Link-Belt Co., 910 So. Michigan Ave., Chicago, Ill., gives full description of its positive drives in books No. 125. Silent Chain; No. 1257, Roller Chain; No. 815, Herringbone Speed Reducers; No. 1050, Promal Chains. Send for these positive power transmission books.

Community Advertising

610. Booklet showing various forms of publicity matter useful in arousing interest in the construction of small town water supplies. This matter is furnished free to Consulting Engineers and towns interested in waterworks construction by The Cast Iron Pipe Research Association, 566 Peoples Gas Bldg., Chicago, Ill.

Rules

625. The Lufkin Rule Company, Saginaw, Mich.; New York; Windsor, Canada. Manufacturers of Measuring Tapes, Boxwood Rules, Spring Joint Rules, Straight and Folding Steel Rules, Fine Mechanics Tools and Aluminum Folding Rules, General Catalog No. 11.

Transits and Levels

629. Berger engineering and surveying instruments are described in Catalog B, 140 pages. C. L. Berger & Sons, Inc., 37 Williams St. Boston, Mass.

630. Transits and Levels particularly adapted for City, County and State work are described in a 64-page catalog. Warren-Knight Co. 136 No. 12th St. Philadelphia, Pa.

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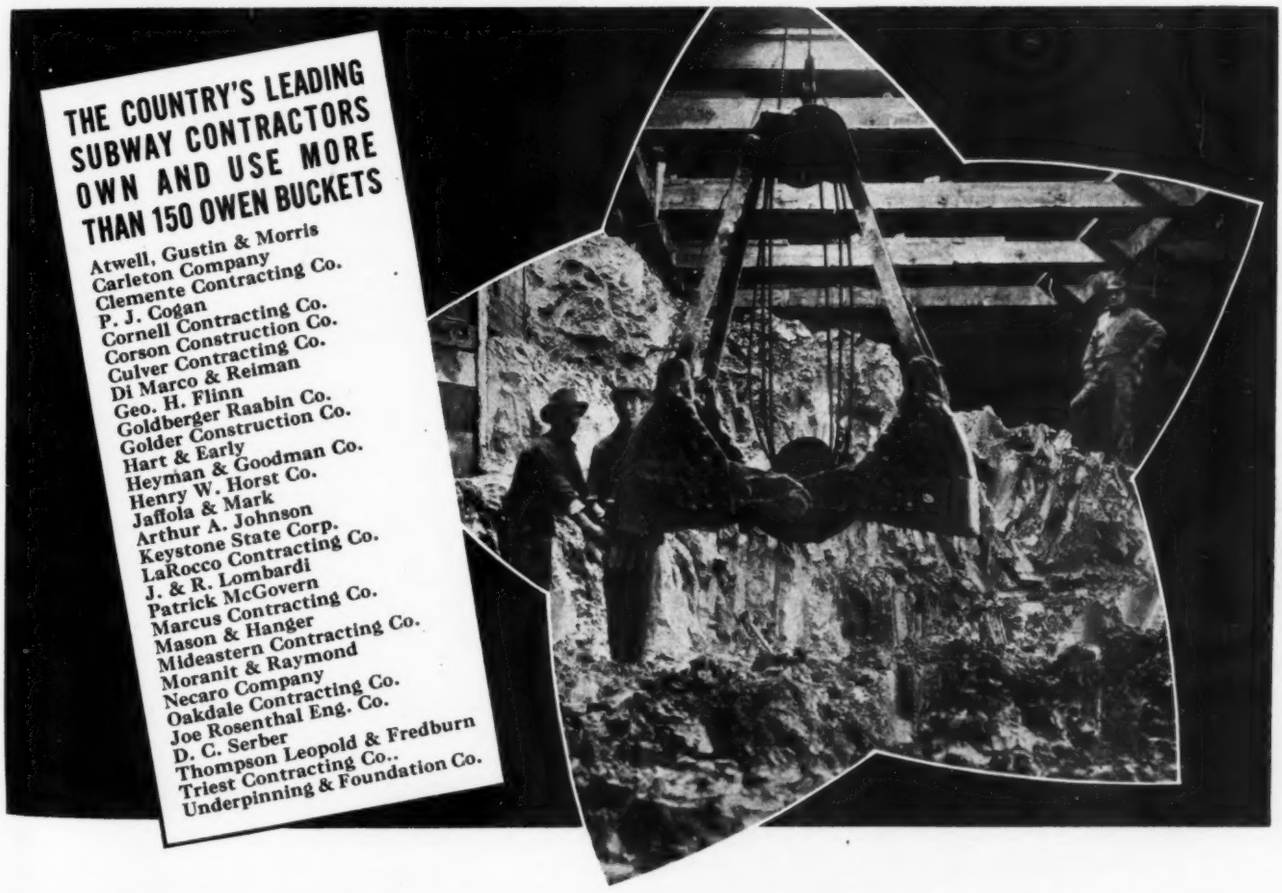
When you want catalogs describing materials or equipment advertised in PUBLIC WORKS, refer to the classified INDUSTRIAL LITERATURE section beginning on page 63 and order by number.

Printed by W.N.U., New York

DIGGING SUBWAYS



Subway construction is difficult work and demands equipment that will guarantee maximum output and uninterrupted performance. Subway digging is primarily a question of moving a lot of material and *moving it fast!* Owen Clamshell Buckets are used on practically all the subway construction jobs in America.

THE OWEN BUCKET CO., CLEVELAND

Owen Buckets

A MOUTHFUL AT EVERY BITE

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Extra fine lenses—flat-brilliant-close focus.
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Easy reading graduations.
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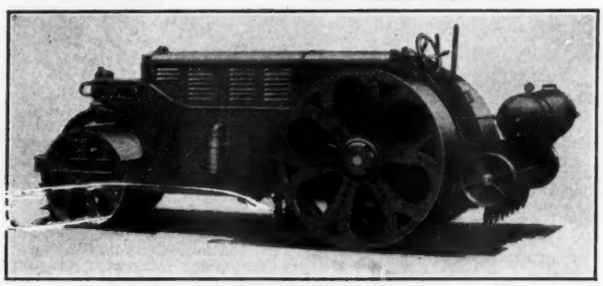
BUILT FOR ALL ROAD JOBS

HUBER MOTOR ROLLERS

5 TO 15 TONS



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Previews and Prescripts

IF you'd ever seen Buckius sweating (and occasionally swearing) on some of those concrete paving jobs, you would have thought he was losing that $1 a minute right out of his own pocket. Well, he sure enough speeded up the work. How many batches an hour is your outfit good for with a 75-second mix? (Page 21 and following). . . . And here's where we help reduce tractor sales. Put one contraption on in front and tie something else on the tail. More work, less equipment (page 38). . . . Well, if you save money that way, then you'll have some to spend for that balanced equipment proposition that Mr. Spears tells about so attractively in the leading article. . . . Ah, yes, what was your dental bill for your power shovel last year? If you blasted right, it ought to be low. Looks nice to see a shovel gobbling up a yard-size boulder (in pictures, anyway), but now they tell us it costs too much money for these depression—I mean reconstruction—times (pages 25 and 33).

JACK HINMAN certainly keeps his nose to the grindstone and apparently in all the magazines, too. How does he do it? Ask him when you see him at Memphis at the AWWA convention. In the meantime, if you want to be able to "speak our language" read up on some of his stuff and be ready for said convention. Jack went through 170 articles last month to give us a liberal education on water works topics. Thanks, Jack, we all appreciate it (page 31 and ad infinitum).

THAT was a cute trick Henry Taylor pulled in setting a baby caisson down under the sludge pockets of his latest sewage plant job. He's got some other cute ideas, too, that we tell about (page 18 and ff). . . . What do you want to know about sludge bed design? Some inside dope on tricks of the trade are let out of the bag by F. B. Barns. . . . Where is the proper location for fire hydrants? Well, where automobiles won't knock them down, and where they will be handy for fires (page 17). . . . What color should you paint your water tank (provided yours is a "tank town")? That's all been worked out, (46) but as usual the engineers have neglected the sex appeal stuff. "Efficiency only" is their motto. Where have we heard of *Psorophora ciliata, Aedes aegypti, Culex quinquefasciatus, et al?* Old familiar names? Well, Noblesville, Ind., just ran the whole family (*sub-family*, we should have said) right out of town, and it didn't cost so much (page 27).

DAVE BATE has a whole bag full of short cuts in street design that are being doled out to an undoubtedly breathless and expectant batch of readers (page 34) . . . How do you build roads without spending much money? These New Englanders know how to do it (page 37). . . . Are the English cracking? Well, some of their concrete roads are, anyway. Why? (page 23) . . . and here we are back where we started with—concrete roads.

And now, having premasticated and predigested this issue for our readers, they are relieved of the necessity of perusing it, and can turn at once to page 13 and work on that monkey problem. Good luck!